Project WET & NGSS

Curriculum and Activity Guide

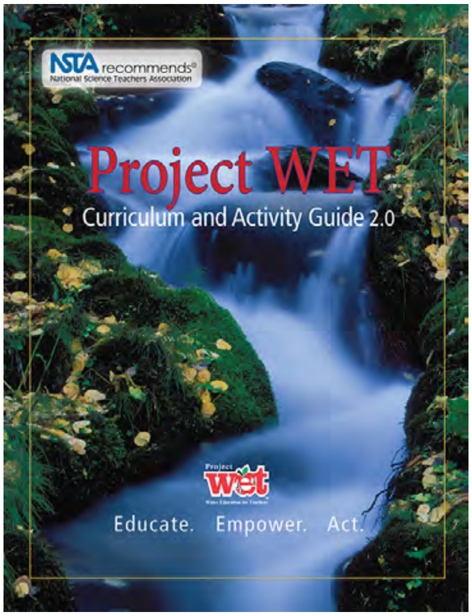
Activity Enhancements

Correlations

Project WET®

Water Education for Teachers

About the correlation process



The Project WET Foundation began the process of re-correlating its activities in the Project WET Curriculum and Activity Guide 2.0 to the Next Generation Science Standards (NGSS) in 2014 with a review of existing Project WET correlations to the NGSS. Reviewers determined the need for a re-correlation of all activities in the Guide.

Project WET used three correlators familiar with NGSS and Project WET to correlate activities to the grade bands defined by NGSS. Correlators created a document for each grade band where the activities correlated to or supported a NGSS performance expectation (PE). The correlations were then reviewed by 25 science curriculum specialists across the U.S., a few of whom helped to write the NGSS. Correlation documents were confirmed, edited and/or updated based on reviews.

The end result is 141 correlations documents for 64 activities in Guide 2.0 and an additional 89 documents for 45 activities in Guide 1.0 with detailed information on how each activity meets each of the three dimensions of a given performance expectation.

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Project WET: 8-4-1, One for All

* Activities are correlated <u>as written.</u> However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: HS	HS-ESS3 Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 299
Brief Lesson Description: Representing eight different water users, students must safely carry one water container "downstream" and must navigate through four simulated water management challenges to reach the next community of water users on the same "river."		
Performance Expectation: HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **(HS-ESS3-1)** • *Students suggest a category title that describes the common element among the cards in the group. (Warm Up)* • *Students discuss right time, right quantity, right quality and right cost related to a specific water user (e.g., farmer or firefighter). (Warm Up)* • *Student groups create a presentation about their water user category with PowerPoint, Windows Movie Maker or other technology. If computers are unavailable, students create a flip book. (Warm Up)* • *Students discuss the results of the activity. (Wrap Up)* • *Students discuss if community water supply and demand are out of balance, how would they resolve the issue? (Wrap Up)* • *Students analyze the challenges they faced as they moved the can of water downriver and specific challenges of each water user in overcoming each obstacle. (Wrap Up)* • *Each student writes a paragraph, tells a story or draws a picture explaining what "8-4-1, One for All" means. They should briefly define each water user category, four common water needs and sharing one river and include how communities throughout their watershed can improve the ways they share water. (Wrap*	**ESS3.A: Natural Resources** Resource availability has guided the development of human society. **(HS-ESS3-1)** • *Explain the significance of the river and obstacles you have made. Discuss the river in the larger context of a watershed.* • *Ask students how water and land use in one community is connected to another. Discuss how communities within your watershed—upstream and downstream—are connected. (Activity, Step 17)* **ESS3.B: Natural Hazards** Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. **(HS-ESS3-1)** • *Explain the significance of the river and obstacles you have made. Discuss the river in the larger context of a watershed.* • *Students must work as a team to pass through the flood (over the rope) and hand off the water to the next community downstream. Have students from Community One hand off their ropes to Community Two as the water moves downstream through the drought obstacle. Do not allow the can to touch the floor. Repeat this process for Communities Three and Four, in turn, for pollution and endangered species.* • *Have students analyze the challenges they faced as they moved the can of water downriver. As a class, discuss the specific challenges of each water user in overcoming each obstacle. Which common water user needs (right amount, right cost, right time or right quality) relate to each obstacle? (Wrap Up)*	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **(HS-ESS3-1)** • *Incorporate a component where measured quantities of water are removed by each water user (similar to Pass the Jug)*

Up) • *Students explain how water quality affects the quantity of water available to water users. (Extensions)* • *Students discuss how carrying water was different with fewer water users. (Extensions)* • *Students discuss the effect changing the length of the string creates when the team tries to carry the can. (Extensions)*		

NGSS Common Core Connections:

ELA/Literacy -

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. ~~*(HS-ESS3-5)*~~

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)

Mathematics -

MP.2 Reason abstractly and quantitatively. ***(HS-ESS3-1)***,(HS-ESS3-2),(HS-ESS3-3),*(HS-ESS3-4)*,(HS-ESS3-5),(HS-ESS3-6)

HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. ***(HS-ESS3-1),****(HS-ESS3-4),(HS-ESS3-5)*,(HS-ESS3-6)

HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ***(HS-ESS3-1),****(HS-ESS3-4)*,(HS-ESS3-5),(HS-ESS3-6)

Connections to other Common Core Standards at this Grade Level:

ELA:-RI.3-12.2; RST.6-12.2; RST.6-12.3; SL.3-12.1; SL.3-12.4; SL.3-12.5; SL.3-6.2; W.3-5.3; WHST.6-12.1

Additional SEP Connections:	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions o that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. o that arise from examining models or a theory, to clarify and/or seek additional information and relationships. o to determine relationships, including quantitative relationships, between independent and dependent variables. o to clarify and refine a model, an explanation, or an engineering problem.
Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Additional Crosscutting Concepts by Grade Level	
Cause and Effect	Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Correlation Comments	**Correlator Initials:** MJW
If this activity could be GREATLY simplified it would be a good fit for Kindergarten standards K-ESS2-2, K-ESS3-1 and K-ESS3-3. Could be used to some degree for 5-ESS3-1, and although the examples given are more wildlife focused, it could also fit with MS-LS2-1. MS-ESS3-1 is somewhat fitting, but is more focused on the geography of natural resources. HS-ESS3-1 is the best fit due to the tie in of both resource availability AND natural hazards, and the fact that the SEP is not quantitative. HS-ESS3-2 is also close and brings in the management aspect, but more focused on evaluating solutions and cost-benefit ratios than this activity is, at present. Finally, HS-ESS3-3, is a great fit in theory, but requires the addition of a quantitative computational component.	

Project WET: Adventures in Density

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** Blue text represents the Extension section of the activity.*

Grade: MS	Topic: Matter and Its Interactions; Earth's Systems	Page #: Guide 2.0, p. 3
Brief Lesson Description: Students conduct investigations to discover how the density of water is affected by heat and salinity and how climate change may affect ocean water density and the North Atlantic heat pump. Students relate their "discoveries" to literary adventures.		
Performance Expectation: MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.		
Performance Expectation: MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. **(MS-PS1-4), (MS-ESS2-6)** • Develop a model to predict and/or describe phenomena. • *Students draw a diagram of what they see when pouring two cups of water, with varying densities due to temperature differences, together. (Student Activity page 9, part a)*	**PS1.A: Structure and Properties of Matter** Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. **(MS-PS1-4)** • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. • *Students explain differences between liquid and ice and match to a density diagram. (Warm Up)* The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **(MS-PS1-4)** • *Students explain differences between liquid and ice and match to a density diagram. (Warm Up)* • *Students compare density of molecules of ice versus molecules of water. (Student Activity, page 10, part c)* **PS3.A: Definitions of Energy** The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. **(secondary to MSPS1-4)** • *Students answer questions related to heat energy and movement of water in Student Activity, page 9, part a)* The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-PS1-4)** • *Students predict how ocean systems behave when changes in temperature and salinity occur. (Student Activity, page 11 under Density and the Ocean)* **Systems and System Models** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. **(MS-ESS2-6)**

	(whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. **(secondary to MS-PS1-4)** • *Students answer questions related to temperature and ocean systems in Student Activity, page 11)* **ESS2.C: The Roles of Water in Earth's Surface Processes** Variations in density due to variations in temperature and salinity drive global pattern of interconnected ocean currents. **(MS-ESS2-6)** • *Students conduct the Adventures in Density lab. (Pages 10-11, Salinity, Temperature and Salinity, Density and the Ocean).* **ESS2.D: Weather and Climate** Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)** The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. **(MS-ESS2-6)** • *Students use word clues to conduct research and share with groups about the relationship between global temperature, ocean density and climate. (Steps 2-5)*	

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1), (MS-PS1-2), (MS-PS1-4),(MS-PS1-5) (Part I, Steps 2-6)

SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-1), (MS-ESS2-2), (MSESS2-6)

Mathematics-

6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)

Connections to other Common Core Standards at this Grade Level: RST. 6-8.1, RST. 6-8.3, RST.6-8.4, RST.6-8.9, RI.6-8.1, RI.6-8.2, RI.6-8.7, RH.6-8.7, WHST.6-8.2b

Additional SEP Connections: Grades 6-8	
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Energy and Matter	Energy and Matter: Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.

Correlation Comments	**Correlator Initials:** ELC

This activity is not perfect to fully address either MS-PS1-4 or MS-ESS2-6, but it did fit most of each, especially when looking at the clarification statements in each category. The missing link is all about the Model part—students could easily add in making a diagram (they do use diagrams to interpret ocean currents) and they do draw a picture of what they see when pouring colored cold water and hot water together. One reviewer also suggested that MS-ESS2-4 might be a good fit and it could connect to the water cycle and climate, if the teacher brought that into the activity's discussion.
More suggestions would be to have students study the temperature influence of the global conveyer belt currents - What are the affects of the Gulf Stream on the coast of western Europe now? How has it influenced the climate there through history? Affects on Polynesian settlement patterns, etc. Great ties to MS Social Studies!!

I also don't know that I think we should go so far as to address the NGSS Common Core Connections that are identified here. None fit very well with the activity and it wouldn't make this one stronger to include them.

Other notes for this activity: On page 10, where there is a note about the amount of salt and egg, but it is on the info given for the student. I think it is fine to give this as a hint for the teacher, but should NOT be something the kids know at that point. It is giving away the punchline/ending ☺
Also, on Page 10, with Temperature and Salinity, the directions are not good for MS students. It would work for HS students, but this activity isn't intended for HS…

Project WET: A-maze-ing Water

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Grade: Kindergarten	Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 231
Brief Lesson Description: Students guide a drop of water through a maze of "drainage pipes" to learn how activities in their homes and yards affect water quality.		
Performance Expectation: K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Obtaining, Evaluating, and Communicating Information Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. **(K-ESS3-3)** • *Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)** • *Students listen to a story such as Joel Harper's 'All the Way to the Ocean' and take notes on storm water effects.*** • *Students create a class list of storm water pollutants based on evidence from the story and direct observation.* • *Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence from the story and direct observation.* • *Students listen to the rest of a story such as Joel Harper's 'All the Way to the Ocean' and take notes on actions people can take to reduce storm water pollutants.*** • *Students work in teams to match their listed actions to listed pollutants.* • *Students create drawings or sketches of a pollutant and an action people can take to reduce storm water pollution.*	**ESS3.C: Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. **(K-ESS3-3)** • *Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters.* • *Students listen to a story such as Joel Harper's 'All the Way to the Ocean' and take notes on storm water effects.*** • *Students create a class list of storm water pollutants based on evidence from the story and direct observation.* • *Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence from the story and direct observation.* • *Students create drawings or sketches of a pollutant and an action people can take to reduce storm water pollution.* **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **(secondary to K-ESS3-3)** • *Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence from the story and direct observation.* • *Students listen to a story such as Joel Harper's 'All the Way to the Ocean' and take notes on storm water effects.*** • *Students record and compare descriptions of new vs. dried storm water paper towel samples.* • *Students create a class list of actions to reduce storm water pollution based on evidence from the story and direct observation.*	**Cause and Effect** Events have causes that generate observable patterns. **(K-ESS3-3)** • *Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters.* • *Students listen to a story such as Joel Harper's 'All the Way to the Ocean' and take notes on storm water effects.*** • *Students create a class list of storm water pollutants based on evidence from the story and direct observation.* • *Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence from the story and direct observation.* • *Students record and compare descriptions of new vs. dried storm water paper towel samples.* • *Students work in teams to match their listed actions to listed pollutants.* • *Students create drawings or sketches of a pollutant and an action people can take to reduce storm water pollution.*

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NGSS Common Core Connections:
ELA/Literacy –
W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS3-3)

Connections to other Common Core Standards at this Grade Level: SL.K-3.3; W.K-4.7

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. • Generate and/or compare multiple solutions to a problem.

Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Systems and System Models: Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Structure and Function	Structure and Function: Students observe the shape and stability of structures of natural and designed objects are related to their function(s).

Correlation Comments	**Correlator Initials:** DBB

The *intent* of A-maze-ing Water correlates to the Kindergarten NGSS Performance Expectations K-ESS3-3, but the components of the activity don't *as written*. However, the content is there and most of the modifications in gray are enhancements of components already in either the K-2 Option or the general activity. The suggested re-alignment outline with the modifications will fully correlate the activity to PE K-ESS3-3 ***and*** opens the door for a teacher to use the activity to build student proficiency toward the Kindergarten Engineering Design PEs. The suggested realignment also creates a constructivist flow that will integrate the K-2 Option directly into the activity.

Highly suggest getting kids interested in the subject by starting with a look at what is going into the storm drain system, rather than *telling* and *asking* or *discussing* the issue with them – *'Lab Before Blab'* gets questions and interest flowing from the kids, as intended by NGSS. Also suggest either we include a better story of our own or recommend a children's book like *'All the Way to the Ocean'* for this activity. Joel Harper's book is set-up perfectly for kids to discover and record storm water pollutants, as well as discover actions they can take to prevent the pollution, thus I've taken the unusual step of suggesting it right in the activity.

Below is the suggested modification outline for just Kindergarten – Please see correlation templates for other grades to see additional components of the suggested activity outline:

Warm-up:

- Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)*
  *This is something students of any age can do and gets even adults into asking questions as well as disgusted by what they observe and where it is going. Of course, this should definitely be conducted under full supervision for Elementary, if not all grades.
- Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters.
- Students record a description of a clean paper towel, then use it to collect a storm water sample for testing. (K-2 Option)
- Students record and compare descriptions of new vs. dried storm water paper towel samples. (K-2 Option)

Part I: Obtaining & Communicating Storm Water Concepts

- Students listen to a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on storm water affects.**
  ** Suggest either we include a better story of our own or recommend a children's book like *'All the Way to the Ocean'* for this activity. Joel Harper's book is set-up perfectly for kids to discover and record storm water pollutants, as well as discover actions they can take to prevent the pollution, thus I've taken the unusual step of suggesting it right in the activity.
- Students create a class list of storm water pollutants based on evidence from the story and direct observation.
- Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence from the story and direct observation.
- Students listen to the rest of a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on actions people can take to reduce storm water pollutants.**
- Students create a class list of actions to reduce storm water pollution based on evidence from the story and direct observation.
- Students work in teams to match their listed actions to listed pollutants.

Part IV: ActionEducation

- Students create drawings or sketches of a pollutant and an action people can take to reduce storm water pollution.

Resources:

'All the Way to the Ocean' – Joel Harper: http://www.amazon.com/All-Way-Ocean-Joel-Harper/dp/0971425418/ref=sr_1_1?ie=UTF8&qid=1450556606&sr=8-1&keywords=children%27s+books+joel+harper

Project WET: A-maze-ing Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	Earth and Human Activity	
Brief Lesson Description: Students guide a drop of water through a maze of "drainage pipes" to learn how activities in their homes and yards affect water quality.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Performance Expectation: 3–5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.		
Performance Expectation: 3–5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Asking Questions and Defining Problems Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. **(3–5-ETS1-1)** • Students describe the 'urban water pollutants' entering the storm water system. • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies. • Students develop a list of actions people can take to limit the contaminants that enter urban runoff. • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to compare criteria based on available data. **Constructing Explanations and Designing Solutions** Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. **(3–5-ETS1-2)** • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence.	**ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)* • Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters. • Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies. • Students develop a list of actions people can take to limit the contaminants that enter urban runoff. • Students research alternatives to chemical products used for house cleaning and lawn care. (Extension) • Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension) • Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension) • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness.	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS3-1)** • Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters. • Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence. • Students simulate storm water runoff on urban streets. (Option 1 or 2) • Students describe the 'urban water pollutants' entering the storm water system. • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to compare criteria based on available data. • Students plan and develop a storm water education and/or storm drain monitoring program. .... ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters.

- Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness.
- Students use graphs and calculations to compare criteria based on available data.
- Students plan and develop a storm water education and/or storm drain monitoring program.
- Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation).

Obtaining, Evaluating, and Communicating Information
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)**

- Students read a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on storm water effects.**
- Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence.
- Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies.
- Students develop a list of actions people can take to limit the contaminants that enter urban runoff.
- Students research alternatives to chemical products used for house cleaning and lawn care. (Extension)
- Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension)
- Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension)
- Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each.
- Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness.
- Students plan and develop a storm water education and/or storm drain monitoring program.
- Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation).

- Students plan and develop a storm water education and/or storm drain monitoring program.
- Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation).

ETS1.A: Defining and Delimiting Engineering Problems
Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **(3–5-ETS1-1)**

- Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)*
- Students read a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on storm water effects.**
- Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence.
- Students describe the 'urban water pollutants' entering the storm water system.
- Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each.
- Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies.
- Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension)

ETS1.B: Developing Possible Solutions
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. **(3–5-ETS1-2)**
At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. **(3–5-ETS1-2)**

- Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence.
- Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each.
- Students develop a list of actions people can take to limit the contaminants that enter urban runoff.
- Students research alternatives to chemical

- Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence.
- Students record a description of a clean paper towel, then use it to collect a storm water sample for testing. (K-2 Option)
- Students record and compare descriptions of new vs. dried storm water paper towel samples. (K-2 Option)

Influence of Engineering, Technology, and Science on Society and the Natural World
People's needs and wants change over time, as do their demands for new and improved technologies. **(3–5-ETS1-1)**
Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. **(3–5-ETS-2)**

- Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each.
- Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness.
- Students use graphs and calculations to compare criteria based on available data.
- Students plan and develop a storm water education and/or storm drain monitoring program.

	products used for house cleaning and lawn care. (Extension) • Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension) • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to compare criteria based on available data. • Students plan and develop a storm water education and/or storm drain monitoring program. • Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation).	

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1), (3–5-ETS1-2)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1), (3–5-ETS1-2)
RI.5.9.a,b	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1),(3–5-ETS1-2)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1),(3–5-ETS1-1)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1),(3–5-ETS1-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-ESS3-1),(3–5-ETS1-1),(3–5-ETS1-2)
MP.4	Model with mathematics. (5-ESS3-1),(3–5-ETS1-1),(3–5-ETS1-2)
MP.5	Use appropriate tools strategically. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.1-4	Represent and solve problems involving multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.5-6	Understand properties of multiplication and the relationship between multiplication and division. (3–5-ETS1-1),(3–5-ETS1-2)
3.OA.7	Multiply and divide within 100. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.4	Gain familiarity with factors and multiples. (3–5-ETS1-1),(3–5-ETS1-2)
4.OA.5	Generate and analyze patterns. (3–5-ETS1-1),(3–5-ETS1-2)
5.OA.3	Analyze patterns and relationships. (3–5-ETS1-1),(3–5-ETS1-2)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.

Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Structure and Function: Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

The *intent* of A-maze-ing Water correlates to the 5th Grade NGSS Performance Expectation 5-ESS3-1, but the components of the activity do not very well *as written*. However, the modifications in gray and suggested re-alignment will correlate the activity to the PE elements ***and*** allows for correlation to the additional Engineering Design PEs: 3–5-ETS1-1 and 3–5-ETS1-2 and most of the connecting CCSS – *including* Math. Math connections are based on the suggested modifications to have students include estimated time and cost criteria in evaluating competing storm water pollution prevention methods, then using graphs and calculations as data allows to assess these strategies.

Highly suggest getting kids interested in the subject by starting with a look at what is going into the storm drain system, rather than *telling* and *asking* or *discussing* the issue with them – *'Lab Before Blab'* gets questions and interest flowing from the kids, as intended by NGSS. Also suggest either we include a better story of our own or recommend a children's book like *'All the Way to the Ocean'* for this activity. Joel Harper's book is set-up perfectly for kids to discover and record storm water pollutants, as well as discover actions they can take to prevent the pollution, thus I've taken the unusual step of suggesting it right in the activity.

Below is the suggested modification outline:

Warm-up:

- Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)*

  *This is something students of any age can do and gets even adults into asking questions as well as disgusted by what they observe and where it is going. Of course, this should definitely be conducted under the full supervision for Elementary, if not all grades.

- Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters.
- Students record a description of a clean paper towel, then use it to collect a storm water sample for testing. (K-2 Option)
- Students record and compare descriptions of new vs. dried storm water paper towel samples. (K-2 Option)

Part l: Obtaining & Communicating Storm Water Concepts

- Students listen to or read a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on storm water effects.**
- Students create a class list of storm water pollutants based on evidence from the story and direct observation.
- Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence.
- Students listen to the rest of a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on actions people can take to reduce storm water pollutants.**

  ** Suggest either we include a better story of our own or recommend a children's book like *'All the Way to the Ocean'* for this activity. Joel Harper's book is set-up perfectly for kids to discover and record storm water pollutants, as well as discover actions they can take to prevent the pollution, thus I've taken the unusual step of suggesting it right in the activity.

- Students create a class list of actions to reduce storm water pollution based on evidence.
- Students work in teams to match their listed actions to listed pollutants.

Part ll: Storm Water Models & Simulations

Option 1: Using a Model to Simulate Storm Water Flow***

***The models are essentially simulating the same thing, but would suggest building the maze model should be the first option from the NGSS perspective and the 'classroom maze' as the secondary option for schools that just can't afford the maze model materials.

- Students design mazes to simulate storm water runoff on urban streets. (Option 2, steps 1-4).
- Students describe the water containing 'urban water pollutants' at the end of the maze simulations.

Option 2: Enacting a Simulated Storm Water Flow

- Students participate in a simulation of water movement and the impact of pollution in an urban environment.
- Students describe the 'urban water pollutants' entering the storm water system.

Part III:

- Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies.
- Students develop a list of actions people can take to limit the contaminants that enter urban runoff.
- Students research alternatives to chemical products used for house cleaning and lawn care. (Extension)
- Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension)
- Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension)
- Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each.
- Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness.
- Students use graphs and calculations to compare criteria based on available data.

Part IV: ActionEducation

- Students create a drawing or sketches of a pollutant and an action people can take to reduce storm water pollution. (K-2) ****
  ****Students invite the school, local community organizations, newspaper and/or storm water education outreach staff to display student storm water education illustrations.
- Students plan and develop a storm water education and/or storm drain monitoring program.
- Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation).

Resources:

'All the Way to the Ocean' – Joel Harper: http://www.amazon.com/All-Way-Ocean-Joel-Harper/dp/0971425418/ref=sr_1_1?ie=UTF8&qid=1450556606&sr=8-1&keywords=children%27s+books+joel+harper

Project WET: A-maze-ing Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	**Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 231
Brief Lesson Description: Students guide a drop of water through a maze of "drainage pipes" to learn how activities in their homes and yards affect water quality.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*		
Performance Expectation: MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
Performance Expectation: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Asking Questions and Defining Problems Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **(MS-ETS1-1)** • Students describe the 'urban water pollutants' entering the storm water system. • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies. • Students develop a list of actions people can take to limit the contaminants that enter urban runoff. • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to compare criteria based on available data. **Constructing Explanations and Designing Solutions** Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students draw, sketch or diagram how	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)* • Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters. • Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies. • Students develop a list of actions people can take to limit the contaminants that enter urban runoff. • Students research alternatives to chemical products used for house cleaning and lawn care. (Extension) • Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension) • Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension) • Students create a chart of storm water pollutants, impact on humans & the environment and prevention strategies for	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • Students record and compare descriptions of new vs. dried storm water paper towel samples. (K-2 Option) • Students diagram how water mixes with pollutants to become storm water based on evidence. • Students describe the water containing 'urban water pollutants' at the end of the maze simulations. • Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies. • Students develop a list of actions people can take to limit the contaminants that enter urban runoff. • Students research alternatives to chemical products used for house cleaning and lawn care. (Extension) • Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension) • Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension) • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to

water mixes with pollutants to become storm water based on evidence. • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to compare criteria based on available data. • Students plan and develop a storm water education and/or storm drain monitoring program. • Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation). **Engaging in Argument from Evidence** Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-ETS1-2)** • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to compare criteria based on available data. • Students plan and develop a storm water education and/or storm drain monitoring program.	each. • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students plan and develop a storm water education and/or storm drain monitoring program. • Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation). **ETS1.A: Defining and Delimiting Engineering Problems** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. **(MS-ETS1-1)** • Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)* • Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence. • Students describe the 'urban water pollutants' entering the storm water system. • Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each. • Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies. • Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension) • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2)** • Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness. • Students use graphs and calculations to compare criteria based on available data. • Students plan and develop a storm water education and/or storm drain monitoring program.	compare criteria based on available data. • Students plan and develop a storm water education and/or storm drain monitoring program. ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ETS1-1)** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-3), (MS-ETS1-1)** • Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)* • Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters. • Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies. • Students develop a list of actions people can take to limit the contaminants that enter urban runoff. • Students research alternatives to chemical products used for house cleaning and lawn care. (Extension) • Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension) • Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education efforts and opportunities for student involvement. (Extension) • Students create a chart of storm water pollutants, impact on humans & the environment and prevention strategies for each. • Students plan and develop a storm water education and/or storm drain monitoring program.

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from

	reading a text on the same topic. (MS-ETS1-2)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-1),(MS-ETS1-1)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3) (MS-ETS1-1)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2)
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3)

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions:
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop and/or use a model to predict and/or describe phenomena.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.

Structure and Function	Structure and Function: Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

A-maze-ing Water *does not* correlate to the MS Grade NGSS Performance Expectations MS-ESS3-3, MS-ETS1-1 or MS-ETS1-2 *as written.* However, the suggested modifications in gray and re-alignment will correlate the activity to the PE elements ***and*** most of the connecting CCSS. Math connections are based on the suggested modifications to have students include estimated time and cost criteria in evaluating competing storm water pollution prevention methods, then using graphs and calculations, as data allows, to assess these strategies.

Highly suggest finding a good news article or overview of storm water issues for MS Grade students to read in lieu of the recommended book or story for Elementary grades – Something that grabs their attention, as well as makes clear why they should care about storm water pollution.

Below is the suggested modification outline:

Warm-up:

- Students conduct an investigation to observe what kind of material is carried by storm water. (ActionEducation)*

  *This is something students of any age can do and gets even adults into asking questions as well as disgusted by what they observe and where it is going. Of course, this should definitely be conducted under full supervision for Elementary, if not all grades.

- Students record descriptions of the material observed in and around a storm drain and/or in connecting gutters.
- Students record a description of a clean paper towel, then use it to collect a storm water sample for testing. (K-2 Option)
- Students record and compare descriptions of new vs. dried storm water paper towel samples. (K-2 Option)

Part I: Obtaining & Communicating Storm Water Concepts

- Students listen to or read a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on storm water affects.**
- Students create a class list of storm water pollutants based on evidence from the story and direct observation.
- Students draw, sketch or diagram how water mixes with pollutants to become storm water based on evidence.
- Students listen to the rest of a story such as Joel Harper's *'All the Way to the Ocean'* and take notes on actions people can take to reduce storm water pollutants.**

  ** Suggest either we include a better story of our own or recommend a children's book like *'All the Way to the Ocean'* for this activity. Joel Harper's book is set-up perfectly for kids to discover and record storm water pollutants, as well as discover actions they can take to prevent the pollution, thus I've taken the unusual step of suggesting it right in the activity.

- Students create a class list of actions to reduce storm water pollution based on evidence from the story and direct observation.
- Students work in teams to match their listed actions to listed pollutants.

Part II: Storm Water Models & Simulations

Option 1: Using a Model to Simulate Storm Water Flow***

***The models are essentially simulating the same thing, but I would suggest building the maze model should be the first option from the NGSS perspective and the 'classroom maze' as the secondary option for schools that just can't afford the maze model materials.

- Students design mazes to simulate storm water runoff on urban streets. (Option 2, steps 1-4).
- Students describe the water containing 'urban water pollutants' at the end of the maze simulations.

Option 2: Enacting a Simulated Storm Water Flow

- Students participate in a simulation of water movement and the impact of pollution in an urban environment.
- Students describe the 'urban water pollutants' entering the storm water system.

Part III:

- Students research and discuss ways in which contaminated water affects aquatic life and drinking water supplies.
- Students develop a list of actions people can take to limit the contaminants that enter urban runoff.
- Students research alternatives to chemical products used for house cleaning and lawn care. (Extension)
- Students contact the local recycling center, the waste treatment facility or a local environmental group for information on waste/litter prevention strategies. (Extension)
- Students invite a representative from the local storm water control or water district to discuss storm water management issues, public education

efforts and opportunities for student involvement. (Extension)

- Students create a chart of storm water pollutants, impact on humans & the environment, and prevention strategies for each.
- Students develop a list of criteria and rate each strategy – including estimated cost, time and evidence of effectiveness.
- Students use graphs and calculations to compare criteria based on available data.

Part IV: ActionEducation

- Students create drawings or sketches of a pollutant and an action people can take to reduce storm water pollution. (K-2) ****
  ****Students invite the school, local community organizations, newspaper and/or storm water education outreach staff to display student storm water education illustrations.
- Students plan and develop a storm water education and/or storm drain monitoring program.
- Students design a brochure describing steps individuals and communities can take to prevent surface water contamination (ActionEducation).

Resources:

'All the Way to the Ocean' – Joel Harper: http://www.amazon.com/All-Way-Ocean-Joel-Harper/dp/0971425418/ref=sr_1_1?ie=UTF8&qid=1450556606&sr=8-1&keywords=children%27s+books+joel+harper

Project WET: Aqua Bodies

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: 4</td><td>From Molecules to Organisms: Structures and Processes</td><td>Project WET Guide, Page #:
Guide 2.0, p. 45</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students demonstrate how much of their bodies are composed of water, where water is found within their bodies and the functions of water in their bodies.</td></tr>
<tr><td colspan="3">Performance Expectation: 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.</td></tr>
<tr><td>Science & Engineering Practice(s)</td><td>Disciplinary Core Idea(s)</td><td>Crosscutting Concept(s)</td></tr>
<tr>
<td>Engaging in Argument from Evidence
Construct an argument with evidence, data, and/or a model. (4-LS1-1)
• Students make observations of fresh and dried examples of the same foods. (Extensions)
• Students predict what they think might happen to people if they don’t drink enough water.
• Students develop a method to divide their diagrams into a grid of 10 equal proportions.
• Students indicate what percentage of their bodies is water by coloring an equal percentage of their diagram.(Part I, steps 2-3).
• Students estimate the percentage of water in body organs (Part II, step 3).
• Students graph and compare the percentage of water in body organs.
• Students develop a list of what they think are the major functions of water in the body (Part III, step 1).
• Students research on their own or read the article ‘The Water in You’ to determine major functions of water in the body.
• Students develop an educational poster or brochure that raises their school's awareness of the important role that water plays in the human body.
.</td>
<td>LS1.A: Structure and Function
Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.(4-LS1-1)
• Students make observations of fresh and dried examples of the same foods. (Extensions)
• Students predict what they think might happen to people if they don’t drink enough water.
• Students develop a list of areas where they think water is found in their bodies (Part II, steps 1 and 2).
• Students estimate the percentage of water in body organs (Part II, step 3).
• Students graph and compare the percentage of water in body organs.
• Students label their diagrams to indicate where the major organs are found in their bodies..
• Students develop a list of what they think are the major functions of water in the body (Part III, step 1).
• Students research on their own or read the article ‘The Water in You’ to determine major functions of water in the body.
• Students develop an educational poster or brochure that raises their school's awareness of the important role that water plays in the human body.</td>
<td>Systems and System Models
A system can be described in terms of its components and their interactions. (4-LS1-1)
• Students make observations of fresh and dried examples of the same foods. (Extensions)
• Students predict what they think might happen to people if they don’t drink enough water.
• Students work in teams to create a full-size diagram of their body.
• Students develop a method to divide their diagrams into a grid of 10 equal proportions.
• Students develop a list of areas where they think water is found in their bodies (Part II, steps 1 and 2).
• Students estimate the percentage of water in body organs (Part II, step 3).
• Students label their diagrams to indicate where the major organs are found in their bodies.
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</tr>
<tr><td colspan="3">NGSS Common Core Connections:
ELA/Literacy –
W.4.1.a–d Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)
Mathematics –
4.G.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)</td></tr>
</table>

Additional SEP Connections: Grades 3-5	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.

Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Structure and Function: Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions

Correlation Comments	**Correlator Initials:** DBB

Aqua Bodies generally correlates to the 4th grade NGSS Performance Expectations 4-LS1-1, but the alignment could be greatly enhanced to better correlate to the PE dimensions and address the connection CCSS. Below is a suggested summary of the student action items to highlight – many are already in the activity, but are currently not highlighted – and a suggested revised flow that is very close to what is already in the guide.

Warm-up –

- *Students make observations of fresh and dried examples of the same foods. (Extensions)*
- *Students predict what they think might happen to people if they don't drink enough water.*
- *Students develop an estimate for the percentage of water in their bodies referencing prior knowledge.*

Part I:

- *Students work in teams to create a full-size diagram of their body.*
- *Students develop a method to divide their diagrams into a grid of 10 equal proportions.*
- *Students indicate what percentage of their bodies is water by coloring an equal percentage of their diagram.(Part I, steps 2-3).*
- *Students compare the weight of fresh and dried versions of the same foods and calculate the amount of water (by weight) the food contained. (Extensions)*
- *Students calculate what they would weigh if they lost as much water as their food sample.*

Part II:

- *Students develop a list of areas where they think water is found in their bodies (Part II, steps 1 and 2).*
- *Students estimate the percentage of water in body organs (Part II, step 3).*
- *Students graph and compare the percentage of water in body organs.*
- *Students label their diagrams to indicate where the major organs are found in their bodies..*

Part III:

- *Students develop a list of what they think are the major functions of water in the body (Part III, step 1).*
- *Students research on their own or read the article 'The Water in You' to determine major functions of water in the body.*

Part IV: ActionEducation

- *Students develop an educational poster or brochure that raises their school's awareness of the important role that water plays in the human body.*

Resources

USGS ' The Water in You' : *http://water.usgs.gov/edu/propertyyou.html*

Project WET: Aqua Bodies

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

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Guide 2.0, p. 45</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students demonstrate how much of their bodies are composed of water, where water is found within their bodies and the functions of water in their bodies.</td></tr>
<tr><td colspan="3">Performance Expectation: MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</td></tr>
<tr><td>Science & Engineering Practice(s)</td><td>Disciplinary Core Idea(s)</td><td>Crosscutting Concept(s)</td></tr>
<tr><td>Engaging in Argument from Evidence
Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)
• Students predict what they think might happen to their body if it doesn't get enough water.
• Students develop a list of areas where they think water is found in their bodies (Part II, steps 1 and 2).
• Students estimate the percentage of water in body organs (Part II, step 3).
• Students graph and compare the percentage of water in body organs.
• Students develop a list of what they think are the major functions of water in the body and relationship to the major organs (Part III, step 1).
• Students revise their diagrams to show the interaction of major organs and water in the human body.
• Students develop an educational poster or brochure that raises their school's awareness of the important role that water plays in the human body.
.</td><td>LS1.A: Structure and Function
In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)
• Students make observations of fresh and dried examples of the same foods. (Extensions)
• Students predict what they think might happen to people if they don't drink enough water.
• Students make observations of fresh and dried examples of the same foods.
• Students compare the weight of fresh and dried versions of the same foods and calculate the amount of water (by weight) the food contained. (Extensions)
• Students calculate what they would weigh if they lost as much water as their food sample.
• Students describe what they think might happen to their body if it doesn't get enough water.
• Students develop a list of areas where they think water is found in their bodies (Part II, steps 1 and 2).
• Students label their diagrams to indicate where the major organs are found in their bodies.
• Students develop a list of what they think are the major functions of water in the body and relationship to the major organs (Part III, step 1).
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Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)
• Students make observations of fresh and dried examples of the same foods. (Extensions)
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• Students revise their diagrams to show the interaction of major organs and water in the human body.
• Students develop an educational poster or brochure that raises their school's awareness of the important role that water plays in the human body.
....
Connections to Nature of Science

Science is a Human Endeavor
Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)
• Students make observations of fresh and dried examples of the same foods.
• Students compare the weight of fresh and dried</td></tr>
</table>

		versions of the same foods and calculate the amount of water (by weight) the food contained. (Extensions) • *Students calculate what they would weigh if they lost as much water as their food sample.* • *Students describe what they think might happen to their body if it doesn't get enough water.*

NGSS Common Core Connections:
ELA/Literacy –
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3)
RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3)
WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-3)

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions ▪ that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. ▪ to identify and/or clarify evidence and/or the premise(s) of an argument. ▪ to determine relationships between independent and dependent variables and relationships in models. ▪ to clarify and/or refine a model, an explanation, or an engineering problem. ▪ that require sufficient and appropriate empirical evidence to answer. ▪ that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. ▪ that challenge the premise(s) of an argument or the interpretation of a data set.
Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Analyze and interpret data to provide evidence for phenomena.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Structure and Function: Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Correlation Comments	**Correlator Initials:** DBB

Aqua Bodies has a weak correlation to the MS grade NGSS Performance Expectations MS-LS1-3, but the correlation could be greatly enhanced by revising the activity flow and highlighting the modifications shaded in gray to better align to the PE dimensions and address the connection CCSS. Many of the areas in gray are already in the activity, but are currently not highlighted or integrated into the activity as below.

Warm-up –

- *Students make observations of fresh and dried examples of the same foods. (Extensions)*
- *Students predict what they think might happen to people if they don't drink enough water.*
- *Students develop an estimate for the percentage of water in their bodies referencing prior knowledge.*

Part I:

- *Students work in teams to create a full-size diagram of their body.*
- *Students develop a method to divide their diagrams into a grid of 10 equal proportions.*
- *Students indicate what percentage of their bodies is water by coloring an equal percentage of their diagram.(Part I, steps 2-3).*
- *Students compare the weight of fresh and dried versions of the same foods and calculate the amount of water (by weight) the food contained. (Extensions)*
- *Students calculate what they would weigh if they lost as much water as their food sample.*

Part II:

- *Students develop a list of areas where they think water is found in their bodies (Part II, steps 1 and 2).*
- *Students estimate the percentage of water in body organs (Part II, step 3).*
- *Students graph and compare the percentage of water in body organs.*
- *Students label their diagrams to indicate where the major organs are found in their bodies..*

Part III:

- *Students develop a list of what they think are the major functions of water in the body (Part III, step 1).*
- *Students research on their own or read the article 'The Water in You' to determine major functions of water in the body.*

Part IV: ActionEducation

Students develop an educational poster or brochure that raises their school's awareness of the important role that water plays in the human body.

Resources

USGS ' The Water in You' : *http://water.usgs.gov/edu/propertyyou.html*

Project WET: Aqua Notes

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 4	**From Molecules to Organisms: Structures and Processes**	**Project WET Guide, Page #:** Guide 2.0, p. 51
Brief Lesson Description: While singing simple, fun songs about water in the body, students gain an appreciation for the many ways they need water.		
Performance Expectation: 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior and reproduction.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). **(4-LS1-1)** • Construct an argument with evidence, data, and/or a model.	**LS1.A: Structure and Function** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. **(4-LS1-1)** • *Students list ways that the human body uses water. (Warm Up)* • *Students sing songs about how the human body needs water and what it uses water for. (Part I)* • *Students color the body parts that need water after they sing. (Part II)* • *Students summarize ways the human body uses water. (Wrap Up)*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(4-LS1-1), (4-LS1-2)** • *Students list ways that the human body uses water. (Warm Up)* • *Students sing songs about how the human body needs water and what it uses water for. (Part I)* • *Students color the body parts that need water after they sing. (Part II)* • *Students summarize ways the human body uses water. (Wrap Up)*
NGSS Common Core Connections: ***ELA/Literacy –*** **W.4.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1) ***Mathematics –*** **4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (*4-LS1-1*) **Connections to other Common Core Standards at this Grade Level:** RI. 4-5.2, SL.3-5.5, W.3-5.2, W.3-5.3		

Additional SEP Connections: Grades 3-5	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct and/or support an argument with evidence, data, and/or a model.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Structure and Function: Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Correlation Comments	**Correlator Initials:** ELC
This particular activity leads to the idea of constructing an argument, but never takes it that far. The songs and coloring could serve as evidence to support an argument that the human body needs water to survive (and why does it need water? What is water used for in the body?), but it doesn't quite go that far for this age group. It would be pretty easy to add to the Wrap Up or create another Extension, asking students to write their songs that DO support the *claim* that the human body needs water, by providing *evidence* to support the claims. That would support this particular PE, but also help with the ELA Common Core connection for this PE too. It would be an easy fix, IF we want this activity to be used by older elementary students.	

Project WET: Blue Planet

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: 2</td><td>Earth's Systems</td><td>Project WET Guide, Page #:
Guide 2.0, p. 125</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students participate in a whole body exercise to simulate the movement of water through a river and its watershed.</td></tr>
<tr><td colspan="3">Performance Expectation: 2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.</td></tr>
<tr><td colspan="3">Performance Expectation: 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.</td></tr>
<tr><td colspan="3">Performance Expectation: 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.</td></tr>
<tr><th>Science & Engineering Practice(s)</th><th>Disciplinary Core Idea(s)</th><th>Crosscutting Concept(s)</th></tr>
<tr><td>Developing and Using Models
Develop a model to represent patterns in the natural world. (2-ESS2-2)
• Students identify land and water areas on a globe. (PreK – 2 Option)
• Students count and sort to determine that water covers the greater area of a globe of the Earth. (PreK – 2 Option)
• Students color a sketch of the Earth to determine that water covers the greater area of Earth. (PreK – 2 Option)
• Students identify locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc. on a map or globe.

Constructing Explanations and Designing Solutions
Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)
• Students count and sort to determine that water covers the greater area of a globe of the Earth. (PreK – 2 Option)
• Students color a sketch of the Earth to determine that water covers the greater area of Earth. (PreK – 2 Option)
• Students read stories or gather and label pictures describing locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc.
• Students order images of where water resides on the planet from shortest to longest time and compare with other groups and to actual estimates.</td>
<td>ESS1.C: The History of Planet Earth
Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)
• Students read stories or gather and label pictures describing locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc.
• Students order images of where water resides on the planet from shortest to longest time and compare with other groups and to actual estimates (Part II, steps 1-6).

ESS2.B: Plate Tectonics and Large-Scale System Interactions
Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)
• Students identify land and water areas on a globe. (PreK – 2 Option)
• Students count and sort to determine that water covers the greater area of a globe of the Earth. (PreK – 2 Option)
• Students color a sketch of the Earth to determine that water covers the greater area of Earth. (PreK – 2 Option)
• Students identify locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc. on a map or globe.

ESS2.C: The Roles of Water in Earth's Surface Processes
Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)
• Students identify land and water areas on a globe. (PreK – 2 Option)
• Students count and sort to determine that water covers the greater area of a globe of the Earth. (PreK – 2 Option)
• Students color a sketch of the Earth to determine that water covers the greater area of Earth. (PreK – 2 Option)</td>
<td>Patterns
Patterns in the natural world can be observed. (2-ESS2-2), (2-ESS2-3)
• Students identify land and water areas on a globe. (PreK – 2 Option)
• Students read stories or gather and label pictures describing locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc.
• Students order images of where water resides on the planet from shortest to longest time and compare with other groups and to actual estimates.

Stability and Change
Things may change slowly or rapidly. (2-ESS1-1)
• Students read stories or gather and label pictures describing locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc.
• Students order images of where water resides on the planet from shortest to longest time and compare with other groups and to actual estimates.</td></tr>
</table>

Obtaining, Evaluating, and Communicating Information Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. **(2-ESS2-3)** • *Students identify land and water areas on a globe. (PreK – 2 Option)* • *Students count and sort to determine that water covers the greater area of a globe of the Earth. (PreK – 2 Option)* • *Students color a sketch of the Earth to determine that water covers the greater area of Earth. (PreK – 2 Option)* • *Students read stories or gather and label pictures describing locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc.* • *Students identify locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc. on a map or globe.*	• *Students read stories or gather and label pictures describing locations where water resides on the planet – i.e., ocean, rivers, lakes, glaciers, etc.* • *Students order images of where water resides on the planet from shortest to longest time and compare with other groups and to actual estimates.*	

NGSS Common Core Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-ESS1-1)

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1)

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1), (2-ESS2-3)

SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
a. Give and follow three- and four-step oral directions. (2-ESS1-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (2-ESS2-1), (2-ESS2-2)

MP.4 Model with mathematics. (2-ESS1-1), (2-ESS2-2)

2.NBT.1-4 Understand place value. (2-ESS1-1)

2.NBT.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2)

Connections to other Common Core Standards at this Grade Level: SL.K-12.1; SL.K-12.6; 2.MD.10

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Scale, Proportion, and Quantity	Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Stability and Change	Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** DBB
Blue Planet correlates to the 2nd grade NGSS Performance Expectations 2-ESS2-1, 2-ESS2-2 and 2-ESS2-3 *as written*, BUT only if elements from the activity are integrated into the existing K-2 Option and I've included a few other suggestions shaded in gray in the correlations to the dimensions to better align the activity and correlate to the connecting CCSS. I would also love to see the existing Pre K-2 Option integrated into a revision of the activity directions to create a differentiated flow from 2nd grade up, but didn't see a quick and easy way to do this. Suggest running all of this by the ECE group on the P & P WET team and others with expertise at these grade levels.	

Project WET: Blue Planet

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**Blue text represents the Extension section of the activity.*

Grade: 5	Earth's Systems	Project WET Guide, Page #: Guide 2.0, p. 125
Brief Lesson Description: Students estimate the percentage of Earth's surface that is covered by water and, by tossing an inflatable globe, take a simple probability sample to check their estimates.		
Performance Expectation: 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Using Mathematics and Computational Thinking Describe and graph quantities such as area and volume to address scientific questions. (**5-ESS2-2**) • *Students use probability and statistics to determine proportions of beads in a container. (Warm Up)* • *Students compare direct count to probability and statistical estimate of beads in a container. (Warm-up)* • *Students estimate the percentage of Earth's surface that is covered by water.* • *Students use probability and statistics to determine proportions of water to land on the surface of the Earth.* • *Students draw a pie chart illustrating their estimate of the amount of water and land on Earth (Part I, step 12).* • *Students draw a pie chart representing 71 percent of Earth's surface as water and 29 percent as land and compare to their estimate (Part I, step 12).* • *Students investigate the statistical effects of different map projections on estimating Earth surface water supplies.* • *Students estimate how long water remains in locations such as rivers, lakes, ground water and the ocean and compare with other groups to determine best estimates (Part II, steps 1-6).* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean.*	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (**5-ESS2-2**) • *Students estimate the percentage of Earth's surface that is covered by water.* • *Students use probability and statistics to determine proportions of water to land on the surface of the Earth.* • *Students draw a pie chart representing 71 percent of Earth's surface as water and 29 percent as land and compare to their estimate (Part I, step 12).* • *Students estimate how long water remains in locations such as rivers, lakes, ground water and the ocean and compare with other groups to determine best estimates (Part II, steps 1-6).* • *Students produce a digital slideshow of images reinforcing the idea of Earth as the blue planet (Part II, step 13).* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (**5-ESS3-1**) • *Students produce a digital slideshow of images reinforcing the idea of Earth as the blue planet*	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight and volume. (**5-ESS2-2**) • *Students use probability and statistics to determine proportions of beads in a container. (Warm Up)* • *Students compare direct count to probability and statistical estimate of beads in a container. (Warm-up)* • *Students use probability and statistics to determine proportions of water to land on the surface of the Earth.* • *Students draw a pie chart illustrating their estimate of the amount of water and land on Earth (Part I, step 12).* • *Students draw a pie chart representing 71 percent of Earth's surface as water and 29 percent as land and compare to their estimate (Part I, step 12).* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students estimate how long water remains in locations such as rivers, lakes, ground water and the ocean and compare with other groups to determine best estimates (Part II, steps 1-6).* • *Students investigate the statistical effects of different map projections on estimating Earth surface water supplies.*

Obtaining, Evaluating, and Communicating Information Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (**5-ESS3-1**) • *Students produce a digital slideshow of images reinforcing the idea of Earth as the blue planet (Part ll, step 13).* • *Students investigate the statistical effects of different map projections on estimating Earth surface water supplies.* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* • *Students investigate and present on ongoing research to provide plentiful, clean water for all people who need it, now and into the future. (Extension)*	*(Part ll, step 13).* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* • *Students investigate and present on ongoing research to provide plentiful, clean water for all people who need it, now and into the future. (Extension)*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS3-1)** • *Students estimate how long water remains in locations such as rivers, lakes, ground water and the ocean and compare with other groups to determine best estimates (Part II, steps 1-6).* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students produce a digital slideshow of images reinforcing the idea of Earth as the blue planet (Part ll, step 13).* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5- ESS3-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-2),(5-ESS3-1)

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

RST.6-12.7

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-2)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2),(5-ESS3-1)

W.5.9.a,b Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-2),(5-ESS3-1)

MP.4 Model with mathematics. (5-ESS2-2),(5-ESS3-1)

Connections to other Common Core Standards at this Grade Level: SL.K-12.1; SL K-12.6; 5.NBT.5

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Energy and Matter	Students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB
Blue Planet correlates to 5th grade NGSS Performance Expectations 5-ESS2-2 and 5-ESS3-1 *as written*, but does not connect as well to the connecting CCSS for language arts, unless the currently listed extension suggestions are incorporated into the activity. Also highly suggest adding directions to have students develop a probability test to run on different map projections of the Earth and compare the results – i.e., does the map projection matter? This question has come up several times using the globe and has led a study of map projections in history classes, which is consistent with content in 5th – MS history. This element is connected to many of the CCSS, SEP and CCC elements shaded in gray and would strengthen several NGSS dimensions – Suggest adding it either at the end of the globe toss component of the activity or as a recommended Extension noted at the end of this portion of the activity. Suggested adding the existing extensions – research water availability and changing students *discussing* to *investigating and presenting* on ongoing research around the world to provide plentiful, clean water – as a Part III: ActionEducation element. These actions would also reinforce connections to many of the areas shaded in gray above. Would love to see the existing Pre K-2 Option integrated into a revision of the existing Warm – Up to create a differentiated flow and help these teachers not feeling like an afterthought in our activities, but didn't see a quick and easy way to do this. Suggest running this by the ECE group on the P & P WET team and others with expertise at these grade levels.	

Project WET: Blue Planet

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	Earth's Systems	Project WET Guide, Page #: Guide 2.0, p. 125
Brief Lesson Description: By estimating and calculating the percentage of available fresh water on Earth, students understand that this resource must be used and managed carefully.		
Performance Expectation: MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.		
Performance Expectation: MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-ESS3-4)** • *Students use probability and statistics to determine proportions of water to land on the surface of the Earth.* • *Students draw a pie chart representing 71 percent of Earth's surface as water and 29 percent as land and compare to their estimate (Part I, step 12).* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* • *Students investigate and present on ongoing research to provide plentiful, clean water for all people who need it, now and into the future. (Extension)* **Constructing Explanations and Designing Solutions** Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **(MS-ESS3-1)** • *Students use probability and statistics to determine proportions of water to land on the surface of the Earth.*	**ESS3.A: Natural Resources** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. **(MS-ESS3-1)** • *Students estimate the percentage of Earth's surface that is covered by water.* • *Students use probability and statistics to determine proportions of water to land on the surface of the Earth.* • *Students produce a digital slideshow of images reinforcing the idea of Earth as the blue planet (Part II, step 13).* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* **ESS3.C: Human Impacts on Earth Systems** Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-4)** • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* • *Students investigate and present on ongoing research to provide plentiful,*	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-ESS3-1), (MS-ESS3-4)** • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ESS3-1), (MS-ESS3-4)** • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* • *Students investigate and present on ongoing research to provide plentiful, clean water for all people who need it, now and into the future. (Extension)* .... ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. **(MS-ESS3-4)**

• *Students draw a pie chart representing 71 percent of Earth's surface as water and 29 percent as land and compare to their estimate (Part I, step 12).* • *Students produce a digital slideshow of images reinforcing the idea of Earth as the blue planet (Part ll, step 13).* • *Students graph and compare the estimated volume of water in locations such as rivers, lakes, ground water and the ocean vs. graphs of estimated percentage and residence time of water in these locations.* • *Students research Water Distribution and Availability maps and predict our water future. (Extension)* • *Students investigate and present on ongoing research to provide plentiful, clean water for all people who need it, now and into the future. (Extension)*	*clean water for all people who need it, now and into the future. (Extension)*	• *Students research Water Distribution and Availability maps and predict our water future. (Extension)* • *Students investigate and present on ongoing research to provide plentiful, clean water for all people who need it, now and into the future. (Extension)*

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1), (MS-ESS3-4)

WHST.6-8.1 Write arguments focused on discipline content. (MS-ESS3-4)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1), (MS-ESS3-4)

Mathematics –

Connections to other Common Core Standards at this Grade Level: SL.K-12.1; SL K-12.6; WHST.6-12.6; 6.NS.3; 6.RP.3d; 7.SP.1; 7.SP.2; 7.SP.6

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Analyze and interpret data to provide evidence for phenomena.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	Correlator Initials: DBB

Blue Planet does not correlate to either of the MS grade NGSS Performance Expectations MS-ESS3-1 and MS-ESS3-4 *as written*, but could connect and at least support building student knowledge and skills toward both PEs and the connecting CCSS if the currently listed extension suggestions and other suggested modifications in gray are incorporated into the activity.

Also highly suggest adding directions to have students develop a probability test to run on different map projections of the Earth and compare the results – i.e., does the map projection matter? This question has come up several times using the globe and has led a study of map projections in history classes, which is consistent with content in 5^{th} – MS history. This element is connected to many of the CCSS, SEP and CCC elements shaded in gray and would strengthen several NGSS dimensions – Suggest adding it either at the end of the globe toss component of the activity or as a recommended Extension noted at the end of this portion of the activity.

Suggested adding the existing extensions – research water availability and changing students *discussing* to *investigating and presenting* on ongoing research around the world to provide plentiful, clean water – as a Part III: ActionEducation element. These actions would also reinforce connections to many of the areas shaded in gray above.

Would love to see the existing Pre K-2 Option integrated into a revision of the existing Warm – Up to create a differentiated flow and help these teachers not feeling like an afterthought in our activities, but didn't see a quick and easy way to do this. Suggest running this by the ECE group on the P & P WET team and others with expertise at these grade levels.

Project WET: Blue River

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Grade: 2	**Earth's Systems:** **Processes that Shape the Earth**	**Project WET Guide, Page #:** Guide 2.0, p. 135
Brief Lesson Description: Students participate in a whole body exercise to simulate the movement of water through a river and its watershed.		
Performance Expectation: 2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.		
Performance Expectation: 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.		
Performance Expectation: 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Developing and Using Models Develop a model to represent patterns in the natural world. **(2-ESS2-2)** • *Students are introduced to the major components of a watershed. (Part I, steps 3-5).* • *Students simulate the annual movement of water through a river and its watershed. (Part II, Steps 1 – 8)* • *Students simulate how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students use evidence from the simulation to create a diagram (map) of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).* • *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)* • *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students simulate and use grade appropriate math to analyze and graph describe how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* **Constructing Explanations and Designing Solutions** Make observations from several sources to construct an evidence-based account for natural phenomena. **(2-ESS1-1)** • *Students listen to a story, poem or song of seasonal events on a river.* • *Students simulate the annual movement of*	**ESS1.C: The History of Planet Earth** Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. **(2-ESS1-1)** • *Students listen to a story, poem or song of seasonal events on a river.* • *Students simulate the annual movement of water through a river and its watershed. (Part II, Steps 1 – 8)* • *Students simulate how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students create a picture galley of their local watershed showing water in each season.* **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps show where things are located. One can map the shapes and kinds of land and water in any area. **(2-ESS2-2)** • *Students use evidence from the simulation to create a diagram (map) of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).* • *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* **ESS2.C: The Roles of Water in Earth's Surface Processes** Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. **(2-ESS2-3)** • *Students listen to a story, poem or song of seasonal events on a river.*	**Patterns** Patterns in the natural world can be observed. **(2-ESS2-2), (2-ESS2-3)** • *Students use evidence from the simulation to create a diagram (map) of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).* • *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students simulate and describe how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* • *Students create a picture galley of their local watershed showing water in each season.* **Stability and Change** Things may change slowly or rapidly. **(2-ESS1-1),** • *Students simulate the annual movement of water through a river and its watershed. (Part II, Steps 1 – 8)* • *Students simulate how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up)* • *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students create a picture galley of their*

water through a river and its watershed. (Part II, Steps 1 – 8) • *Students simulate how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students use evidence from the simulation to create a diagram (map) of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* • *Students create a picture galley of their local watershed showing water in each season.* **Obtaining, Evaluating, and Communicating Information** Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. **(2-ESS2-3)** • *Students listen to a story, poem or song of seasonal events on a river.* • *Students use evidence from the simulation to create a diagram (map) of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).* • *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* • *Students create a picture galley of their local watershed showing water in each season.* • *Students write a story, poem or song of seasonal events on a local river.*	• *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students describe how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students use evidence from the simulation to create a diagram (map) of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).* • *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* • *Students create a picture galley of their local watershed showing water in each season.* • *Students write a story, poem or song of seasonal events on a local river.*	*local watershed showing water in each season.*

NGSS Common Core Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-ESS1-1)

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1)

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1), (2-ESS2-3)

SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
a. Give and follow three- and four-step oral directions. (2-ESS1-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (2-ESS2-1), (2-ESS2-2)
MP.4 Model with mathematics. (2-ESS1-1), (2-ESS2-2)
2.NBT.1-4 Understand place value. (2-ESS1-1)
2.NBT.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s).
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Distinguish between explanations that account for all gathered evidence and those that do not. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Systems and System Models: Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Stability and Change	Stability and Change: Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** DBB

Blue River correlates well to 2nd grade NGSS Performance Expectations 2-ESS1-1, 2-ESS2-2 and 2-ESS2-3 *as written* but needs tweaks in gray to strengthen CCSS correlations– primarily the addition of directions to have students read additional, grade appropriate text or stories on fictional or historical events about flowing rivers. However, there are questions regarding the grade level appropriateness of some of the vocabulary introduced and definitely the existing Warm-up discussion – Suggest either using a having students listen to a story or learn a song about a flowing river that can be sung as students do the simulation.

Suggest revising activity as outlined below, and asking ECE group in P & P WET team review this activity for grade level appropriate vocabulary and methodology.

Warm-up –

- *Students listen to a story, poem or song of seasonal events on a river.*

Part I: Simulating a Watershed

- *Students are introduced to the major components of a watershed. (Part I, steps 3-5). (2nd Grade)*
- *Students simulate the annual movement of water through a river and its watershed. (Part II, Steps 1 – 8)*
- *Students simulate how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).*
- *Students use evidence from the simulation to create a diagram (map) of a watershed, including labeling the major components of a watershed.*

(Part I, steps 3-5).

- *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)*
- *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).*
- *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).*

Part II: Simulation to Reality

- *Students identify the major components of a watershed on a map of their watershed.*
- *Students identify prominent land and water bodies on a map of their watershed.*

Grade 2

- *Students create a picture galley of their local watershed showing water in each season.*
- *Students write a story, poem or song of seasonal events on a local river.*

Resources:

'Water We Singing About' – Kevin Kopp
'River Song' – Banana Slug String Band
River of Words

Project WET: Blue River

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	Earth's Systems	Project WET Guide, Page #: Guide 2.0, p. 135
Brief Lesson Description: Students participate in a whole body exercise to simulate the movement of water through a river and its watershed.		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Performance Expectation: 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model using an example to describe a scientific principle. (**5-ESS2-1**) • *Students simulate the annual movement of water through a river and its watershed. (Part II, Steps 1 – 8)* • *Students simulate how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).* • *Students create a diagram of the simulated watershed, labeling the major components of a watershed. (Part I, steps 3-5).* • *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* **Using Mathematics and Computational Thinking** Describe and graph quantities such as area and volume to address scientific questions. (**5-ESS2-2**) • *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students simulate and compare hydrographs to assess the affect of changing stream gage locations within a watershed.* • *Students simulate and compare hydrographs to assess contribution of individual tributaries to the total flow of a river.*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. (**5-ESS2-1**) • *Students discuss the quotation "You can never step into the same river twice…"* • *Students create a diagram of the simulated watershed, labeling the major components of a watershed. (Part I, steps 3-5).* • *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students simulate and compare hydrographs to assess the affect of changing stream gage locations within a watershed.* • *Students simulate and compare hydrographs to assess contribution of individual tributaries to the total flow of a river.* • *Students simulate and compare hydrographs to assess how changes within individual tributaries can affect the total flow of a river.* **ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (**5-ESS2-2**) • *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)* • *Students describe the movement of water through*	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight and volume. (**5-ESS2-2**) • *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students research how a stream gage works and how communities use the data.* • *Students simulate and compare hydrographs to assess the affect of changing stream gage locations within a watershed.* • *Students simulate and compare hydrographs to assess contribution of individual tributaries to the total flow of a river.* • *Students simulate and compare hydrographs to assess how changes within individual tributaries can affect the total flow of a river.* **Systems and System Models** A system can be described in terms of its components and their interactions. (**5-ESS2-1), (5-ESS3-1)** • *Students discuss the quotation "You can never step into the same river twice…"* • *Students use evidence from the simulation to create a diagram of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).*

• *Students simulate and compare hydrographs to assess how changes within individual tributaries can affect the total flow of a river.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (**5-ESS3-1**) • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* • *Students research how a stream gage works and how communities use the data.*	*a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* • *Students simulate and compare hydrographs to assess contribution of individual tributaries to the total flow of a river.* • *Students simulate and compare hydrographs to assess how changes within individual tributaries can affect the total flow of a river.* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (**5-ESS3-1**) • *Students research how a stream gage works and how communities use the data.* • *Students simulate and compare hydrographs to assess the affect of changing stream gage locations within a watershed.* • *Students simulate and compare hydrographs to assess contribution of individual tributaries to the total flow of a river.* • *Students simulate and compare hydrographs to assess how changes within individual tributaries can affect the total flow of a river.*	• *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)* • *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).* • *Students identify the major components of a watershed on a map of their watershed.* • *Students identify prominent land and water bodies on a map of their watershed.* • *Students simulate and compare hydrographs to assess contribution of individual tributaries to the total flow of a river.* • *Students simulate and compare hydrographs to assess how changes within individual tributaries can affect the total flow of a river.*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2),(5-ESS3-1)

W.5.9.a,b Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1),(5-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

MP.4 Model with mathematics. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

Connections to other Common Core Standards at this Grade Level: 5.NBT.5

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.

Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.

Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

Blue River correlates well to 5th grade NGSS Performance Expectations 5-ESS2-1 and 5-ESS2-2 *as written*, but needs tweaks in gray to correlate to 5-ESS3-1 and strengthen CCSS correlations– primarily the addition of directions to have students read additional, grade appropriate text and/or interpreting and comparing historical hydrograph data for simulated or actual rivers.

Highly suggest revising activity along the lines of the outlined below:

Warm-up –
- *Students discuss the quotation "You can never step into the same river twice…"*

Part I: Simulating a Watershed
- *Students describe the major components of a watershed. (Part I, steps 3-5).*
- *Students simulate the annual movement of water through a river and its watershed. (Part II, Steps 1 – 8)*
- *Students simulate how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).*
- *Students use evidence from the simulation to create a diagram of a watershed, including labeling the major components of a watershed. (Part I, steps 3-5).*
- *Students use evidence from the simulation to develop a definition for the term 'Watershed' (Warm Up)*
- *Students use grade appropriate math to analyze and graph data from the Blue River simulation through the seasons (Part II, steps 3-8; Part III, steps 5-6).*
- *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).*

Part II: Simulation to Reality
- *Students identify the major components of a watershed on a map of their watershed.*
- *Students identify prominent land and water bodies on a map of their watershed.*
- *Students research how a stream gage works and how communities use the data.*

Part III: Investigating Watershed Variables
- *Students simulate and compare hydrographs to assess the affect of changing stream gage locations within a watershed.*
- *Students simulate and compare hydrographs to assess contribution of individual tributaries to the total flow of a river.*
- *Students simulate and compare hydrographs to assess how changes within individual tributaries can affect the total flow of a river.*

Resources:
USGS – Blue River Fact Sheet: www.portal.projectwet.org
How Streamflow is Measured: https://water.usgs.gov/edu/measureflow.html
How the U.S. Geological Survey monitors water: https://water.usgs.gov/edu/watermonitoring.html
Getting Your Feet Wet—A Day in the Life of a USGS Water Scientist: https://www2.usgs.gov/homepage/science_features/water_scientist.asp

Project WET: Blue River

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	Earth's Systems; Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 135
Brief Lesson Description: Students participate in a whole body exercise to simulate the movement of water through a river and its watershed.		
Performance Expectation: MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.		
Performance Expectation: MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.		
Performance Expectation: MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop and use a model to describe phenomena. **(MS-ESS2-1)** • *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e., El Nino, constructing a dam, land use changes, drought etc. (Extension)* • *Students create and compare hydrographs for each altered Blue River simulation.* • *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper* http://maps.waterdata.usgs.gov/mapper/index.html • *Students use digital map and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.* **Analyzing and Interpreting Data** Analyze and interpret data to determine similarities and differences in findings. **(MS-ESS3-2)** • *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use digital map and hydrograph data to describe seasonal flow patterns on*	**ESS2.A: Earth's Materials and Systems** The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **(MS-ESS2-2)** • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use digital map and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.* **ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movement—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. **(MS-ESS2-2)** • *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e., El Nino, constructing a dam, land use changes, drought etc. (Extension)* • *Students use digital maps and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use digital maps and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.*	**Patterns** Graphs, charts, and images can be used to identify patterns in data. **(MS-ESS3-2)** • *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students use digital maps and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use digital masp and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.* • *Students use hydrograph data to identify climate (seasonal variations) trends and weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.* **Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **(MS-ESS2-2)** • *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).* • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use digital maps and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.*

stream and interpret potential natural or human causes of large variants in annual monthly data sets.

- *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.*

Constructing Explanations and Designing Solutions

Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. **(MS-ESS2-2)**

- *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).*
- *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).*
- *Students describe how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).*
- *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.*
- *Students use digital map and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.*
- *Students use hydrograph data to describe evidence of climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 year or greater in a watershed.*

ESS3.B: Natural Hazards

Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. **(MS-ESS3-2)**

- *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).*
- *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e.,* El Nino*, constructing a dam, land use changes, drought etc. (Extension)*
- *Students use digital maps and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.*
- *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.*

- *Students use hydrograph data to identify climate (seasonal variations) trends and/ or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.*

Stability and Change

Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. **(MS-ESS2-1)**

- *Students create a hydrograph from annual data sets and interpret water flow events through the seasons (Part II, steps 3-8; Part III, steps 5-6).*
- *Students describe the movement of water through a watershed during each season (Part II, steps 2-8; Wrap Up).*
- *Students describe how local weather can affect stream systems in a watershed (Part II, step 9; Wrap Up).*
- *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e.,* El Nino*, constructing a dam, land use changes, drought etc. (Extension)*
- *Students use digital masp and hydrograph data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets.*
- *Students use hydrograph data to identify climate (seasonal variations) trends and/ or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.*

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Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-2)**

- *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e.,* El Nino*, constructing a dam, land use changes, drought etc. (Extension)*
- *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper http://maps.waterdata.usgs.gov/mapper/index.html*
- *Students use digital maps and hydrograph*

		data to describe seasonal flow patterns on stream and interpret potential natural or human causes of large variants in annual monthly data sets. • *Students use digital maps and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use hydrograph data to describe evidence of climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.*

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2), (MS-ESS2-3), (MS-ESS3-2)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS2-3), (MS-ESS3-2)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)

SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-1), (MS-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (MS-ESS2-2), (MS-ESS3-2)

Connections to other Common Core Standards at this Grade Level: RST.6-12.4; 6.SP.4

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales

Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.

Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB
Blue River correlates to MS grade NGSS Performance Expectations **MS-ESS2-1** *as written*, but not to the connecting CCSS correlations. Realigning the activity and adopting the modifications in gray to enhance the activity would correlate it to additional PEs - **MS-ESS2-2** and **2-ESS2-3**, as well as all connecting CCSS. An ActionEducation or Extension component for MS and HS would be for students to investigate changing hydrograph patterns or data anomalies through time and develop an explanation/argument using additional information gathered by students, including reference to other science reports and noting comparisons to geoscience data and models related to the subject of the student investigation.	

Project WET: Blue River

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: HS	Earth's Systems; Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 135
Brief Lesson Description: Students participate in a whole body exercise to simulate the movement of water through a river and its watershed.		
Performance Expectation: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.		
Performance Expectation: HS-ESS3–5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. **(HS-ESS2-2), (HS-ESS3–5)** • *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e., El Nino, constructing a dam, land use changes, drought etc. (Extension)* • *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper http://maps.waterdata.usgs.gov/mapper/index.html* • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.* • *Students use data to build an argument that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.* .... ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** Science investigations use diverse methods and do not always use the same set of procedures to obtain data. **(HS-ESS3–5)** New technologies advance scientific knowledge. **(HS-ESS3–5)** • *Students are challenged to alter the 'Blue River' model to simulate other scenarios*	**ESS2.A: Earth's Materials and Systems** Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **(HS-ESS2-2)** • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.* • *Students use data to build an argument that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.* **ESS2.D: Weather and Climate** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. **(HS-ESS2-2)** • *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e., El Nino, constructing a dam, land use changes, drought etc. (Extension)* • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years or greater, in a watershed.* • *Students use data to build an argument*	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. **(HS-ESS2-2)** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. **(HS-ESS3–5)** • *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e., El Nino, constructing a dam, land use changes, drought etc. (Extension)* • *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper http://maps.waterdata.usgs.gov/mapper/index.html* • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.* • *Students use data to build an argument that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.* .... ***Connections to Engineering, Technology, and Applications of Science*** ***Influence of Science, Engineering, and Technology on Society and the Natural World*** *New technologies can have deep impacts on society and the environment, including some that are not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.* ***(HS-ESS2-2)***

affecting stream hydrology – i.e., El Nino, constructing a dam, land use changes, drought etc. (Extension) • *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper* http://maps.waterdata.usgs.gov/mapper/index.html • *Students use data to build an argument that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.* **Scientific Knowledge is Based on Empirical Evidence** Science knowledge is based on empirical evidence. **(HS-ESS3–5)** Science arguments are strengthened by multiple lines of evidence supporting a single explanation. **(HS-ESS3–5)** • *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper* http://maps.waterdata.usgs.gov/mapper/index.html • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.* • *Students use data to build an argument that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.*	*that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.* **ESS3.D: Global Climate Change** Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. **(HS-ESS3–5)** • *Students are challenged to alter the 'Blue River' model to simulate other scenarios affecting stream hydrology – i.e., El Nino, constructing a dam, land use changes, drought etc. (Extension)* • *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper* http://maps.waterdata.usgs.gov/mapper/index.html • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use hydrograph data to identify climate (seasonal variations) trends and/or weather (precipitation) anomalies in data sets of 30 years, or greater, in a watershed.* • *Students use data to build an argument that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.*	• *Students create hydrographs of local or state streams using data obtained using an on-line resource – i.e., National Map or USGS Mapper* http://maps.waterdata.usgs.gov/mapper/index.html • *Students use digital map and hydrograph data to compare and contrast seasonal flow patterns between stream systems within the area or state.* • *Students use data to build an argument that changes to the Earth's surface are or are not consistent with their 'Blue River' model alterations and existing geoscience models.*

NGSS Common Core Connections:

ELA/Literacy –

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS2-2), (HS-ESS3–5)

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS2-2), (HS-ESS3–5)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ESS3–5)

Mathematics –

MP.2 Reason abstractly and quantitatively. (HS-ESS2-2), (HS-ESS3–5)

N-Q.1-3 Reason quantitatively and use units to solve problems. (HS-ESS2-2), (HS-ESS3–5)

Connections to other Common Core Standards at this Grade Level: RST.6-12.4

Additional SEP Connections: Grades 9-12	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	• Ask questions
	  • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
	  • that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
	  • to determine relationships, including quantitative relationships, between independent and dependent variables.
	  • to clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.

Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.
Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	Systems and System Models: Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.
Stability and Change	Stability and Change: Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments	**Correlator Initials:** DBB
Blue River does not correlate well to the High School NGSS Performance Expectations **HS-ESS2-2 and HS-ESS3–5** *as written*, but may do so using the addition of elements and directions consistent with the areas in gray and the notes below. Highly suggest modifying activity to better align with NGSS elements at 5th and higher grades to include a Part IV integrating most of the existing Extension elements noted in correlation and a Part V that walks students through hydrographing and reading a USGS gauge report and then using the USGS Mapper website to pull and analyze stream flow data from local or regional gauges. I already do this latter component in every workshop using 'Blue River' and have an example USGS gauge report with data that can be used as an example that also provides an example of how humans change the environment. Analysis of data should include looking at stream flow data over a 30+ year period and have students noting seasonal variants and/or trends in the data consistent with climate change. An ActionEducation or Extension component for MS and HS would be for students to investigate changing hydrograph patterns or data anomalies through time and develop an explanation/argument using additional information gathered by students, including reference to other science reports and noting comparisons to geoscience data and models related to the subject of the student investigation.	

Project WET: Branching Out!

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

**Blue text demonstrates the Extension section of the activity.*

Grade: MS	Earth's Systems	Project WET Guide, Page #: Guide 1.0, p. 129
Brief Lesson Description: Students build a model landscape to investigate how water flows through and connects watersheds.		
Performance Expectation: NA		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy – NA*** ***Mathematics – NA***		

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Develop and/or use a model to predict and/or describe phenomena.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. (*Wrap Up and last Extension*)

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** ELC

In *Branching Out!* at the MS level, the 2nd and 3rd Extensions (paragraphs) in the activity are important to lead to the following NGSS PEs:

MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (Extension 2)

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (Extension 3)

I didn't feel like the connection was quite strong enough to include them here, but with tiny tweaks, I do think they would fit. For Extension 2, the directions would need to be more explicit, asking students to provide evidence for their explanations, perhaps with more information required to support their answers. In addition, they would need to have something they were required to do (written, oral, etc.) as they “consider the effects of natural and human-induced elements”.

For Extension 3, students are asked to “introduce human influences such as towns and roads”, but then need to do something with that. If they were to design such a landscape, then how might they minimize the human impact?

With Design in mind and the fact that students are making models of a watershed in this activity, it also seems that this activity could become an Engineering activity for both the Extensions and the entire activity. Really, all 4 items in MS-ETS1-1-4 (Page 74, NGSS DCI) could be incorporated, if desired.

There were still several additional SEPs and CCCs that fit with the entire activity and some that only applied to the Extensions with proposed changes mentioned above. As a teacher, I would still find value in this activity and all of the SEP and CCC connections, but would want to use the Extensions to make a stronger fit with NGSS.

It is a great activity to illustrate a watershed and introduce students to using topographic maps! ☺

Project WET: Color Me a Watershed

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 4	Earth's Systems	Project WET Guide, Page #: Guide 2.0, p. 239
Brief Lesson Description: Through interpretation of maps, students observe how development can affect a watershed.		
Performance Expectation: 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.		
Performance Expectation: 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Planning and Carrying Out Investigations Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. **(4-ESS2-1)** • *Students develop a list of information features provided by each map, including map date, scale and legend.* • *Students graph and compare land use patterns in a watershed through time. (Options 1).* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students calculate how much area is occupied by each land use type through time. (Option 2)* • *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.* • *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.* • *Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity.* • *Students compare land use area and water volume data using graphs , percentages and ratios.* **Analyzing and Interpreting Data** Analyze and interpret data to make sense of phenomena using logical reasoning. **(4-ESS2-2)** • *Students compare patterns observed on a variety of maps for a community and/or*	**ESS2.A: Earth Materials and Systems** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. **(4-ESS2-1)** • *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.* • *Students describe how surface runoff is influenced by changes in land use (Option 2).* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity.* • *Students compare land use area and water volume data using graphs , percentages and ratios.* • *Students describe how surface runoff is influenced by changes in land use (Option 2).* **ESS2.B: Plate Tectonics and Large-Scale System Interactions** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. **(4-ESS2-2)** • *Students compare patterns observed on a variety of maps for a community and/or watershed.* • *Students use an online Geographic Information System (GIS) program to explore land use patterns and changes over time in their own watershed. (Extension)* • *Students calculate how much area is occupied by each land use type through time. (Option 2)*	**Patterns** Patterns can be used as evidence to support an explanation. **(4-ESS2-2)** • *Students compare patterns observed on a variety of maps for a community and/or watershed.* • *Students graph and compare land use patterns in a watershed through time. (Options 1).* • *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)* • *Students calculate how much area is occupied by each land use type through time. (Option 2)* • *Students compare land use area and water volume data using graphs , percentages and ratios.* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students describe how surface runoff is influenced by changes in land use (Option 2).* **Cause and Effect** Cause and effect relationships are routinely identified, tested, and used to explain change. **(4-ESS2-1)** • *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)* • *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns*

watershed. • Students develop a list of information features provided by each map, including map date, scale and legend. • Students graph and compare land use patterns in a watershed through time. (Options 1). • Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1) • Students calculate how much area is occupied by each land use type through time. (Option 2) • Students compare land use area and water volume data using graphs , percentages and ratios. • Students describe how surface runoff is influenced by changes in land use (Option 2).	• Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension) **ESS2.E: Biogeology** Living things affect the physical characteristics of their regions. **(4-ESS2-1)** • Students compare patterns observed on a variety of maps for a community and/or watershed. • Students graph and compare land use patterns in a watershed through time. (Options 1). • Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1). • Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension) • Students describe how surface runoff is influenced by changes in land use (Option 2). • Students compare land use area and water volume data using graphs , percentages and ratios. • Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.	and changes over time in their own watershed. (Extension) • Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity. • Students compare land use area and water volume data using graphs , percentages and ratios. • Students describe how surface runoff is influenced by changes in land use (Option 2).

NGSS Common Core Connections:

ELA/Literacy –

RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1)

W.4.8.a–d Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, paraphrase, and categorize information, and provide a list of sources. (4-ESS1-1),(4-ESS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (4-ESS2-1)

MP.4 Model with mathematics. (4-ESS2-1)

MP.5 Use appropriate tools strategically. (4-ESS2-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Structure and Function: Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

As currently written, Color Me a Watershed *does not* align to the core DCI, clarification statement for the 4th grade PE 4-ESS2-2 or connecting CCSS, a teacher may decide to use the general theme of using maps to study land use patterns to address the associated SEP and CCC in part I and II of the activity to help students build their knowledge and skills toward this PE.

However, if the activity is re-aligned as outlined below to include the modifications in gray, the activity will completely nail all aspects of the 4th grade PE 4-ESS2-2 **and** 4-ESS2-1 – **and** all connecting CCSS. On first glance, neither PE appears to align with this activity a*s written* - the activity currently lacks the more student driven discovery and application to the 'large scale, system interactions' described in DCI ESS2.B, as the existing highlighted student action components all refer to a town, farm or community rather than a watershed-wide analysis as the name of the activity implies. 4-ESS2-1 is focused on weathering and erosion rates, but the clarification statement for this PE clearly states 'volume of water flow' in the examples, which 'Color Me' covers in spades.

A number of the suggested modifications below are merely revising the action statements currently in the activity, as noted by the activity notations at the end of those items. I have only included suggested alignments through Part II of the activity, which addresses the needs for these grade level PEs. Please see activity correlation documents for higher grades to view further alignment suggestions.

Warm-up –
- *Students compare patterns observed on a variety of maps for a community and/or watershed.*
- *Students develop a list of information features provided by each map, including map date, scale and legend.*

Part I: Interpreting Watershed Land Use Patterns
- *Students graph and compare land use patterns in a watershed through time. (Options 1).*
- *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)*
- *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)*

Part II: Quantifying Watershed Land Use & Precipitation Patterns
- *Students calculate how much area is occupied by each land use type through time. (Option 2)*
- *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.*
- *Students compare land use area and water volume data using graphs, percentages and ratios.*
- *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.*
- *Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity.*
- *Students describe how surface runoff is influenced by changes in land use (Option 2).*

Resources
Google Earth: https://earth.google.com
National Map: http://viewer.nationalmap.gov/launch/

Project WET: Color Me a Watershed

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	**Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 239
Brief Lesson Description: Through interpretation of maps, students observe how development can affect a watershed.		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Developing and Using Models Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Students graph and compare land use patterns in a watershed through time. (Options 1).* • *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students calculate how much area is occupied by each land use type through time. (Option 2)* • *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.* • *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.* • *Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • *Students compare patterns observed on a variety of maps for a community and/or watershed.* • *Students develop a list of information features provided by each map, including map date, scale and legend.*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** • *Students graph and compare land use patterns in a watershed through time. (Options 1).* • *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students calculate how much area is occupied by each land use type through time. (Option 2)* • *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.* • *Students compare land use area and water volume data using graphs , percentages and ratios.* • *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.* • *Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity.* • *Students describe how surface runoff is influenced by changes in land use (Option 2).*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1), (5-ESS3-1)** • *Students graph and compare land use patterns in a watershed through time. (Options 1).* • *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)* • *Students compare land use area and water volume data using graphs , percentages and ratios.* • *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.* • *Students describe how surface runoff is influenced by changes in land use (Option 2).* • *Students research and discuss new ideas related to development and runoff. (Extension)* • *Students design a community plan that regulates urban runoff (Wrap Up).* ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Students compare patterns observed on a variety of maps for a community and/or watershed.* • *Students develop a list of information features provided by each map, including map date, scale and legend.*

• *Students compare land use patterns in a watershed through time. (Options 1).* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students compare land use area and water volume data using graphs, percentages and ratios.* • *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.* • *Students describe how surface runoff is influenced by changes in land use (Option 2).* • *Students research and discuss new ideas related to development and runoff. (Extension)* • *Students design a community plan that regulates urban runoff (Wrap Up).*	**ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Students graph and compare land use patterns in a watershed through time. (Options 1).* • *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students calculate how much area is occupied by each land use type through time. (Option 2)* • *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.* • *Students describe how surface runoff is influenced by changes in land use (Option 2).* • *Students research and discuss new ideas related to development and runoff. (Extension)* • *Students design a community plan that regulates urban runoff (Wrap Up).*	• *Students compare land use patterns in a watershed through time. (Options 1).* • *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)* • *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)* • *Students calculate how much area is occupied by each land use type through time. (Option 2)* • *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.* • *Students compare land use area and water volume data using graphs , percentages and ratios.* • *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.* • *Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity.* • *Students describe how surface runoff is influenced by changes in land use (Option 2).*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1), (5-ESS3-1)

RI.5.9.a,b Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)

W.5.9.a,b Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS3-1)

MP.4 Model with mathematics. (5-ESS2-1), (5-ESS3-1)

5.G.2 Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

Connections to other Common Core Standards at this Grade Level: 5.MD.1

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Structure and Function: Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

As currently written, Color Me a Watershed generally aligns to the 5th Grade PE 5-ESS2-1 and weak to nonexistent correlation to 5-ESS3-1. If the activity is re-aligned as outlined below to include the modifications in gray, the activity will correlate well to all aspects of these 5th grade PEs and the connecting CCSS.

A number of the suggested modifications below are merely revising the action statements currently in the activity, as noted by the activity notations at the end of those items. I have only included suggested alignments through Part ll of the activity, which addresses the needs for these grade level PEs. Please see activity correlation documents for higher grades to view further alignment suggestions.

Warm-up –

- *Students compare patterns observed on a variety of maps for a community and/or watershed.*
- *Students develop a list of information features provided by each map, including map date, scale and legend.*

Part I: Interpreting Watershed Land Use Patterns

- *Students graph and compare land use patterns in a watershed through time. (Options 1).*
- *Students analyze and discuss the interrelationship of population growth and settlement patterns on land use changes through time. (Option 1)*
- *Students use an online Geographic Information System (GIS) program to explore land and water body patterns and changes over time in their own watershed. (Extension)*

Part ll: Quantifying Watershed Land Use & Precipitation Patterns

- *Students calculate how much area is occupied by each land use type through time. (Option 2)*
- *Students calculate the volume of water accumulated on a land use area based on a rainfall estimate.*
- *Students compare land use area and water volume data using graphs, percentages and ratios.*
- *Students use an online Geographic Information System (GIS) program to denote land use patterns and calculate changes over time in their own watershed.*
- *Students calculate an estimate of the volume of water that would accumulate on land use areas of their watershed based on the rainfall estimate used in the activity.*
- *Students describe how surface runoff is influenced by changes in land use (Option 2).*

ActionEducation

- *Students research and discuss new ideas related to development and runoff. (Extension)*
- *Students design a community plan that regulates urban runoff (Wrap Up).*

Resources

Google Earth: https://earth.google.com
National Map: http://viewer.nationalmap.gov/launch/

Project WET: Common Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text demonstrates the Extension section of the activity.*

Grade: Kindergarten	**From Molecules to Organisms: Structures and Processes/ Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 249
Brief Lesson Description: Students analyze the results of a simulation to understand that water is a shared resource and is managed.		
Performance Expectation: K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.		
Performance Expectation: K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.		
Performance Expectation: K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Use a model to represent relationships in the natural world. **(K-ESS3-1)** • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (K-2 Option)* • *Students brainstorm actions they can take to save water. (Activity Scenario)* • *Students count the number of wild animals and humans and structures at each stage of the simulation.* • *Students measure the amount of water left at the end of each stage of the scenario.* • *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.* **Analyzing and Interpreting Data** Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. **(K-LS1-1)** • *Students discuss how living things use water. (Warm-up)* • *Students discuss how they use water in their everyday lives. (Warm-up)* • *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.* • *Students discuss the interrelationships among water users in the simulation. (K-2 Option)* • *Students draw and write a story describing the interconnections between water users and less water can be used. (Wrap-up)*	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. **(K-LS1-1)** • *Students discuss how living things use water. (Warm-up)* • *Students discuss how they use water in their everyday lives. (Warm-up)* • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (K-2 Option)* • *Students discuss the interrelationships among water users in the simulation. (K-2 Option)* • *Students draw and write a story describing the interconnections between water users and less water can be used. (Wrap-up)* **ESS3.A: Natural Resources** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. **(K-ESS3-1)** • *Students discuss how living things use water. (Warm-up)* • *Students discuss how they use water in their everyday lives. (Warm-up)* • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (K-2 Option)* • *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.*	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. **(K-LS1-1)** • *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.* • *Students discuss the interrelationships among water users in the simulation. (K-2 Option)* • *Students draw and write a story describing the interconnections between water users and less water can be used. (Wrap-up)* **Cause and Effect** Events have causes that generate observable patterns. **(K-ESS3-3)** • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (K-2 Option)* • *Students brainstorm actions they can take to save water. (Activity Scenario)* • *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.* • *Students discuss the interrelationships among water users in the simulation. (K-2 Option)* • *Students draw and write a story describing the interconnections between water users and less water can be used. (Wrap-up)*

Obtaining, Evaluating, and Communicating Information
Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. **(K-ESS3-3)**

- *Students discuss the interrelationships among water users in the simulation. (K-2 Option)*
- *Students brainstorm actions they can take to save water. (Activity Scenario)*
- *Students draw and write a story describing the interconnections between water users and less water can be used. (Wrap-up)*

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Scientists look for patterns and order when making observations about the world. **(K-LS1-1)**

- *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.*
- *Students discuss the interrelationships among water users in the simulation. (K-2 Option)*
- *Students draw and write a story describing the interconnections between water users and less water can be used. (Wrap-up)*

- *Students discuss the interrelationships among water users in the simulation. (K-2 Option)*
- *Students draw and write a story describing the interconnections between water users and less water can be used. (Wrap-up)*

ESS3.C: Human Impacts on Earth Systems
Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. **(K-ESS3-3)**

- *Students discuss how they use water in their everyday lives. (Warm-up)*
- *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (K-2 Option)*
- *Students brainstorm actions they can take to save water. (Activity Scenario)*
- *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.*
- *Students discuss the interrelationships among water users in the simulation. (K-2 Option)*
- *Students draw and write a story describing the interconnections between water users. (Wrap-up)*

Systems and System Models
Systems in the natural and designed world have parts that work together. **(K-ESS3-1)**

- *Students discuss how living things use water. (Warm-up)*
- *Students discuss how they use water in their everyday lives. (Warm-up)*
- *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (K-2 Option)*
- *Students brainstorm actions they can take to save water. (Activity Scenario)*
- *Students compare the amount of water left at the end of each stage of the scenario to the number of wild animals, humans and human structures in each scenario.*
- *Students discuss the interrelationships among water users in the simulation. (K-2 Option)*

NGSS Common Core Connections:
ELA/Literacy –

W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS3-3)
W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-LS1-1)
SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (K-ESS3-1)
MP.4 Model with mathematics. (K-ESS3-1)
K.CC.1-3 Know number names and the count sequence. (K-ESS3-1)
K.CC.4-5 Count to tell the number of objects. (K-ESS3-1)
K.CC.6-7 Compare numbers. (K-ESS3-1)
K.MD.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-LS1-1)

Connections to other Common Core Standards at this Grade Level: RI.K-2.7; SL.K-2.3; W.K-1.3

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).

Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Use quantitative data to compare two alternative solutions to a problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Stability and Change	Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** DBB
Common Water correlates well to the Kindergarten NGSS Performance Expectations K-LS2-1, K-ESS3-1 and K-ESS3-3, but fails to connect with any of the CCSS connected to the PEs *as written*. The modifications shaded in grey *could* strengthen correlations by adding math and language arts elements aligned to the CCSS supporting these NGSS PEs. Suggest asking those with ECE expertise on P & P WET team and in network to suggest additional modifications for alignment appropriate to the grade level.	

Project WET: Common Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

**Blue text demonstrates the Extension section of the activity.*

Grade: 5	From Molecules to Organisms: Structures and Processes/ Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 249
Brief Lesson Description: Students analyze the results of a simulation to understand that water is a shared resource and is managed.		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Developing and Using Models Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (Part I)* • *Students discuss elements of the simulation model and how well they represented the local community.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • *Students research what the community is doing or should do to maintain clean water supplies. (Wrap-up)* • *Students create a display or mural depicting the ways their community shares its water supply. (Wrap-up)* • *Students interview local water managers to learn about water distribution policies and conservation programs in the community. (Wrap-up)*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** • *Students discuss how they use water in their everyday lives. (Warm-up)* • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (Part I)* • *Students record and discuss observations of water quantity and quality during the simulation.* • *Students create a list of water user groups in the community and discuss how each may be affected by a water shortage. (Extension)* • *Students research what the community is doing or should do to maintain clean water supplies. (Wrap-up)* • *Students create a display or mural depicting the ways their community shares its water supply. (Wrap-up)* • *Students interview local water managers to learn about water distribution policies and conservation programs in the community. (Wrap-up)* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1), (5-ESS3-1)** • *Students discuss how they use water in their everyday lives. (Warm-up)* • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (Part I)* • *Students discuss elements of the simulation model and how well they represented the local community.* • *Students propose and illustrate ways the simulation could be altered so the community could supply its members with clean and ample water supplies (Wrap Up).* • *Students research what the community is doing or should do to maintain clean water supplies. (Wrap-up)* • *Students create a display or mural depicting the ways their community shares its water supply. (Wrap-up)* • *Students interview local water managers to learn about water distribution policies and conservation programs in the community. (Wrap-up)* ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Students research what the community is doing or should do to maintain clean water supplies. (Wrap-up)* • *Students create a display or mural depicting the ways their community shares its water*

	even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Students discuss how they use water in their everyday lives. (Warm-up)* • *Students engage in a simulation on how the use of water by humans can impact all living things in an area. (Part I)* • *Students propose and illustrate ways the simulation could be altered so the community could supply its members with clean and ample water supplies (Wrap-Up).* • *Students create a list of water user groups in the community and discuss how each may be affected by a water shortage. (Extension)* • *Students research what the community is doing or should do to maintain clean water supplies. (Wrap-up)* • *Students create a display or mural depicting the ways their community shares its water supply. (Wrap-up)* • *Students interview local water managers to learn about water distribution policies and conservation programs in the community. (Wrap-up)*	*supply. (Wrap-up)* • *Students interview local water managers to learn about water distribution policies and conservation programs in the community. (Wrap-up)*

NGSS Common Core Connections:
ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1), (5-ESS3-1)
RI.5.9.a,b	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS3-1)

Additional SEP Connections: Grades 3-5

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB
Common Water correlates to the 5th grade NGSS Performance Expectations 5-ESS2-1 and 5-ESS3-1, though the simulation model is more in the realm of social science – but it IS still looking at interactions between the hydrosphere and biosphere. Population numbers and/or amount of people moving into the area and impacting the water resource in the simulation is inherently built into the activity, so students will be thinking quantitatively and abstractly by design – but that is the only CCSS Math that may connect *as written.* Suggestions in gray are to existing directions to make them more student focused and as definite parts of the activity – Many are currently written as options. The change would strengthen activity correlations to the NGSS dimensions – and connect to the associated CCSS for Language Arts. I also suggest a revision in flow to build students toward an action that is a good mix of science and social science:	

Warm-up –
- Students discuss how they use water in their everyday lives.

Part I: Simulating a Water Tragedy of the Commons:
- Students engage in a simulation on how the use of water by humans can impact all living things in an area. (Part I)
- Students propose and illustrate ways the simulation could be altered so the community could supply its members with clean and ample water supplies (Wrap Up).
- Students discuss elements of the simulation model and how well they represented the local community.

Part II: Investigating Our Common Water Supply
- Students research what the community is doing or should do to maintain clean water supplies. (Wrap-up)
- Students create a list of water user groups in the community and discuss how each may be affected by a water shortage.
- Students create a display or mural depicting the ways their community shares its water supply. (Wrap-up)

ActionEducation
- Students interview local water managers to learn about water distribution policies and conservation programs in the community. (Wrap-up)

Extensions
- Students conduct a performance based on '*The Story of Water in Dryville*'. *http://water.usgs.gov/edu/dryville.html*

Project WET: Discover the Waters of Our National Parks

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 2	Earth's Systems/ Biological Evolution: Unity and Diversity	Project WET Guide, Page #: Guide 2.0, p. 493
Brief Lesson Description: Through games, mapping activities and storytelling, students create a Park Life List and plan a trip to their favorite national parks.		
Performance Expectation: 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.		
Performance Expectation: 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.		
Performance Expectation: 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to represent patterns in the natural world. **(2-ESS2-2)** • *Students draw what they think people can do and what they think lives in a National Park.* • *Students revise their illustrations and descriptions of a National Park.* **Planning and Carrying Out Investigations** Make observations (firsthand or from media) to collect data which can be used to make comparisons. **(2-LS4-1)** • *Students describe what they know about National Parks.* • *Students draw what they think people can do and what they think lives in a National Park.* • *Students identify the water and landform features found in National Parks.* • *Students identify the form and state of water observed in pictures of National Parks.* • *Students observe how the presence or absence of water can affect the habitat and plants & animals in an area.* • *Students identify the kinds of plants & animals observed in pictures of National Parks.* • *Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.* **Obtaining, Evaluating, and Communicating Information** Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps show where things are located. One can map the shapes and kinds of land and water in any area. **(2-ESS2-2)** • *Students draw what they think people can do and what they think lives in a National Park.* • *Students locate their closest National Park(s) on a map.* • *Students revise their illustrations and descriptions of a National Park.* • *Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.* **ESS2.C: The Roles of Water in Earth's Surface Processes** Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. **(2-ESS2-3)** • *Students draw what they think people can do and what they think lives in a National Park.* • *Students identify the water and landform features found in National Parks.* • *Students identify the form and state of water observed in pictures of National Parks.* • *Students observe what water and landform features are found in their local National Park(s).* • *Students identify the form and state of water observed in pictures of their local National Park(s) through the year.* **LS4.D: Biodiversity and Humans** There are many different kinds of living things in any area, and they exist in different places on land and in water. **(2-LS4-1)** • *Students draw what they think people can do and what they think lives in a National Park.*	**Patterns** Patterns in the natural world can be observed. **(2-ESS2-2), (2-ESS2-3)** • *Students draw what they think people can do and what they think lives in a National Park.* • *Students observe how the presence or absence of water can affect the habitat and plants & animals in an area.* • *Students revise their illustrations and descriptions of a National Park.*

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scientific question. (2-ESS2-3)
• Students identify the water and landform features found in National Parks.
• Students identify the form and state of water observed in pictures of National Parks.
• Students observe how the presence or absence of water can affect the habitat and plants & animals in an area.
• Students identify the kinds of plants & animals observed in pictures of National Parks.
• Students locate their closest National Park(s) on a map.
• Students revise their illustrations and descriptions of a National Park.
• Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.
• Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Scientists look for patterns and order when making observations about the world. (2-LS4-1)
• Students draw what they think people can do and what they think lives in a National Park.
• Students revise their illustrations and descriptions of a National Park.
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• Students identify the kinds of plants & animals observed in pictures of National Parks.
• Students observe how the presence or absence of water can affect the habitat and plants & animals in an area.
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NGSS Common Core Connections:
ELA/Literacy –
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS2-3)
W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS4-1)
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-LS4-1), (2-ESS2-3)
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Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.

Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.

Correlation Comments	**Correlator Initials:** DBB

Discover the Waters of Our National Parks generally correlates to the 2nd grade NGSS Performance Expectations 2-ESS2-2, but correlations *could* be strengthened to include PEs 2-ESS2-3 and 2-LS4-1 and **all** NGSS dimensions and connections if modifications in grey are made to extend what students will do.

K – 2 - Warm-up: Defining the National Park Idea

- *Students describe what they know about National Parks.*
- *Students draw what they think people can do and what they think lives in a National Park.*

Part I: Observing Images of a Landscape

- *Students identify the water and landform features found in National Parks.*
- *Students identify the form and state of water observed in pictures of National Parks.*
- *Students observe how the presence or absence of water can affect Students observe how the presence or absence of water can affect the habitat and plants & animals in an area.*
- *in an area.*
- *Students identify the kinds of plants & animals observed in pictures of National Parks.*

Part ll:

• *Students locate their closest National Park(s) on a map.*

- *Students observe what water and landform features are found in their local National Park(s).*
- *Students identify the form and state of water observed in pictures of their local National Park(s) through the year.*
- *Students observe how the presence or absence of water affects the habitat and plants & animals in their local National Park(s).*
- *Students identify the kinds of plants & animals are found in their local National Park(s).*

Part IV: ActionEducation

- *Students revise their illustrations and descriptions of a National Park.*
- *Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.*

Web Resources

Find Your Park: http://findyourpark.com/find

Plan Your Park Adventure: http://www.nps.gov/findapark/index.htm

Project WET: Discover the Waters of Our National Parks

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 4	Earth's Systems	Project WET Guide, Page #: Guide 2.0, p. 493
Brief Lesson Description: Through games, mapping activities and storytelling, students create a Park Life List and plan a trip to their favorite national parks.		
Performance Expectation: 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyze and interpret data to make sense of phenomena using logical reasoning. **(4-ESS2-2)** • *Student teams use visual clues to place pictures of National Parks on a terrestrial ecosystem map.* • *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.* • *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.* • *Student teams use unique clues and a map of national park areas to identify each National Park.* • *Student teams identify each park on a map and identify the state(s) it is located in.* • *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.* • *Students describe the importance of water in National Parks using clues used in the activity and information gained from tracing the route of water from each park.*	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. **(4-ESS2-2)** • *Student teams use visual clues to place pictures of National Parks on a terrestrial ecosystem map.* • *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.* • *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.* • *Student teams use unique clues and a map of national park areas to identify each National Park.* • *Student teams identify each park on a map and identify the state(s) it is located in.* • *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.* • *Students describe the importance of water in National Parks using clues used in the activity and information gained from tracing the route of water from each park.*	**Patterns** Patterns can be used as evidence to support an explanation. **(4-ESS2-2)** • *Student teams use visual clues to place pictures of National Parks on a terrestrial ecosystem map.* • *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.* • *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.* • *Student teams use unique clues and a map of national park areas to identify each National Park.* • *Student teams identify each park on a map and identify the state(s) it is located in.* • *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.* • *Students describe the importance of water in National Parks using clues used in the activity and information gained from tracing the route of water from each park.*

NGSS Common Core Connections:
ELA/Literacy –

RI.4.7	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)
W.4.8.a–d	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, paraphrase, and categorize information, and provide a list of sources. (4-ESS2-2)

Other Common Core Connections for this activity: *4.NBT.2; 4.NBT.5*

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Develop and/or use models to describe and/or predict phenomena.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

Correlation Comments	**Correlator Initials:** DBB

Discover the Waters of Our National Parks *does not correlate* to the 4th grade NGSS Performance Expectation 4-ESS2-2 *as written*, but *could* be if the activity was re-aligned as described below and gray areas incorporated into the activity – This is the model used in California workshops.

Warm-up: Defining the National Park Idea

- *Students work individually and in teams to create a description or definition for the term National Park.*
- *Students brainstorm a list of National Park areas they have heard of or visited and group them by type – (i.e., historic site, seashore, recreation area, monument, etc.)*
- *Students work individually and in teams to develop an explanation for the purpose of National Parks.*

Part l: Getting a Clue on National Parks

- *Student teams use visual clues to place pictures of National Parks on a terrestrial ecosystem map.*
- *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.*
- *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.* These steps in the California version focus attention on connecting visual cues to areas on maps and the weather and climate related characteristics of those areas. Terrestrial ecosystem/habitat maps tie in best with this step of the activity – *The National Park area map is used in the clue portion.*
- *Student teams use unique clues and a map of national park areas to identify each National Park.* Park names are not included on the California cards, allowing every team member to focus on identifying each park with the information provided – *Points can be awarded for the number of parks each team can identify to provide a competitive game element if desired – i.e., each team can send a representative to the teacher to verify park answers and can continue trying to identify incorrect answers until the allotted time is up.*
- *Student teams identify each park on a map and identify the state(s) it is located in.*
- *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.*
- *Students describe the importance of water in National Parks using clues used in the activity and information gained from tracing the route of water from each park.*

Part ll: National Parks and Human History

- *Students use clues to describe historic relationships of people with the waters of National Parks.*
- *Student teams use park clues to connect images of artifacts to a park.*
- *Student teams describe the clue(s) they connect to the artifact and describe what the artifact may indicate about the history of the National Park area.* *Suggest artifacts tied to a clue for every park in activity.*
- *Students investigate an artifact and its relationship to the history of the National Park area.*
- *Students investigate the history of a National Park area they would like to visit and develop a presentation to the class using multiple media.*

Part IV: ActionEducation

- *Students work in teams to plan a visit to their local National Park, including route maps, time of year and what water, land and wildlife features they would like to see.*

Web Resources

Find Your Park: http://findyourpark.com/find

Plan Your Park Adventure: http://www.nps.gov/findapark/index.htm

Project WET: Discover the Waters of Our National Parks

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	**Earth's Systems/Earth and Human Activity/ Ecosystems: Interactions, Energy, and Dynamics**	**Project WET Guide, Page #:** Guide 1.0, Portal
Brief Lesson Description: Through games, mapping activities and storytelling, students create a Park Life List and plan a trip to their favorite national parks.		
Performance Expectation: MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop and use a model to describe phenomena. **(MS-ESS2-6)** • *Student teams use visual clues to place pictures of National Parks on a terrestrial ecosystem map.* • *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.* • *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.* • *Student teams use unique clues and a map of national park areas to identify each National Park.* • *Student teams identify each park on a map and identify the state(s) it is located in.* • *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.* • *Students describe the importance of water in National Parks using clues used in the activity and information gained from tracing the route of water from each park.* • *Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.*	**ESS2.D: Weather and Climate** Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. **(MS-ESS2-6)** • *Student teams use visual clues to place pictures of National Parks on a terrestrial ecosystem map.* • *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.* • *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.* • *Student teams use unique clues and a map of national park areas to identify each National Park.* • *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.* • *Students describe the importance of water in National Parks using clues used in the activity and information gained from tracing the route of water from each park.* • *Students use clues to describe historic relationships of people with the waters of National Parks.* • *Student teams use park clues to connect images of artifacts to a park.* • *Student teams describe the clue(s) they connect to the artifact and describe what the artifact may indicate about the history of the National Park area.* • *Students investigate an artifact and its relationship to the history of the National Park area.* • *Students investigate the history of a National*	**Systems and System Models** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. **(MS-ESS2-6)** • *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.* • *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.* • *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.*

	Park area they would like to visit and develop a presentation to the class using multiple media. • *Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.*	

NGSS Common Core Connections:
ELA/Literacy –
SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-6)
Mathematics –

Connections to other Common Core Standards at this Grade Level: RH.6-8.7; RST.6-8.4; W.6-8.2b; WHST.6-8.7

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • to identify and/or clarify evidence and/or the premise(s) of an argument. • to determine relationships between independent and dependent variables and relationships in models. • to clarify and/or refine a model, an explanation, or an engineering problem. • that require sufficient and appropriate empirical evidence to answer. • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. • that challenge the premise(s) of an argument or the interpretation of a data set.
Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or use a model to predict and/or describe phenomena.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.

Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

Discover the Waters of Our National Parks *does not correlate* to the MS grade NGSS Performance Expectation MS-ESS2-6 *as written*, but *could* be if the activity was re-aligned as described below and gray areas incorporated into the activity – This is the model used in California workshops.

The National Parks include some of the prime examples of geoscience processes in action (i.e., Yellowstone, Yosemite, Glacier, Acadia, Pt. Reyes, Big Bend, Lassen Volcanic), as well as ecosystem dynamics that drove the creation of some Parks (i.e., Yellowstone, Redwood, Denali, Great Smokey) and is driving current research – and is dealing with issues of how to deal with increases in human population and consumption within certain parks (i.e., Great Smokey Mountains and Yosemite).

This activity *should* be a natural for building student understanding toward the NGSS PEs at all grade levels between 2 and MS, with potential extension into High School – but would need some serious re-work of the existing activity. Below are the PEs any re-work of the activity should target for this grade level.

Performance Expectation: MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
Performance Expectation: MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
Performance Expectation: MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on

organisms and populations of organisms in an ecosystem.

Performance Expectation: MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Warm-up: Defining the National Park Idea

- *Students work individually and in teams to create a description or definition for the term National Park.*
- *Students brainstorm a list of National Park areas they have heard of or visited and group them by type – (i.e., historic site, seashore, recreation area, monument, etc.)*
- *Students work individually and in teams to develop an explanation for the purpose of National Parks.*

Part l: Getting a Clue on National Parks

- *Student teams use visual clues to place pictures of National Parks on a terrestrial ecosystem map.* These steps in the California version focus attention on connecting visual cues to areas on maps and the weather and climate related characteristics of those areas. Terrestrial ecosystem/habitat maps tie in best with this step of the activity – *The National Park area map is used in the clue portion.*
- *Student teams make a list of the visual clues they observed and use them to describe why it fits the region on the map where they placed each National Park.*
- *Student teams compare their reasons and placement of National Parks on a map to identify evidence and patterns related to the presence or absence of water.*
- *Student teams use unique clues and a map of national park areas to identify each National Park.* Park names are not included on the California cards, allowing every team member to focus on identifying each park with the information provided – *Points can be awarded for the number of parks each team can identify to provide a competitive game element if desired – i.e., each team can send a representative to the teacher to verify park answers and can continue trying to identify incorrect answers until the allotted time is up.*
- *Student teams identify each park on a map and identify the state(s) it is located in.*
- *Student teams identify water bodies associated with each National Park and trace the route of rivers flowing through National Parks, noting cities or other major water users.*
- *Students describe the importance of water in National Parks using clues used in the activity and information gained from tracing the route of water from each park.*

Part ll: National Parks and Human History *Suggest artifacts tied to a clue for every park in activity and be weather/climate related.*

- *Students use clues to describe historic relationships of people with the waters of National Parks.*
- *Student teams use park clues to connect images of artifacts to a park.*
- *Student teams describe the clue(s) they connect to the artifact and describe what the artifact may indicate about the history of the National Park area.*
- *Students investigate an artifact and its relationship to the history of the National Park area.*
- *Students investigate the history of a National Park area they would like to visit and develop a presentation to the class using multiple media.*

Part VI: ActionEducation

- *Students work in teams to plan a visit to their local National Park, including time of year and what water, land and wildlife features they would like to see.*

Web Resources

Find Your Park: http://findyourpark.com/find

Plan Your Park Adventure: http://www.nps.gov/findapark/index.htm

Climate Friendly Parks; http://www.nps.gov/subjects/climatechange/cfpprogram.htm

United States Ecosystems Mapping: http://rmgsc.cr.usgs.gov/ecosystems/usa.shtml

Project WET: A Drop in the Bucket

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 5	**Earth's Systems/ Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 257
Brief Lesson Description: By estimating and calculating the percentage of available fresh water on Earth, students understand that this resource must be used and managed carefully.		
Performance Expectation: 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Using Mathematics and Computational Thinking Describe and graph quantities such as area and volume to address scientific questions. **(5-ESS2-2)** • *Students estimate the proportion of potable water on Earth (Warm Up)* • *Students determine and graph the proportion of Earth's available fresh water (Warm Up and Wrap Up).* • *Students estimate the volume of potable water available for human use.* • *Students calculate and graph the volume of water available for human use (step 5).* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and calculate the impact that this growth will cause and possible solutions. (Extension)* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • *Students read U.S. Geological Survey report 'Estimated Use of Water in the United States in 2010' and analyze how water is used in the United States. (Extension used in CA).* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions. (Extension)* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and discuss the impact that this growth will cause and possible solutions. (Extension)* • *Students develop a television commercial or other presentation outlining reasons why water is a limited and also renewable resource (Wrap-Up).* • *Students investigate and share knowledge of*	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. **(5-ESS2-2)** • *Students determine and graph the proportion of Earth's available fresh water (Warm-Up and Wrap-Up).* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions. (Extension)* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Students read U.S. Geological Survey report 'Estimated Use of Water in the United States in 2010' and analyze how water is used in the United States.* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and discuss the impact that this growth will cause and possible solutions. (Extension)* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and calculate the impact that this growth will cause and possible solutions. (Extension)* • *Students develop a television commercial or other presentation outlining reasons why water is a limited and also renewable*	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight, and volume. **(5-ESS2-2)** • *Students determine and graph the proportion of Earth's available fresh water (Warm-Up and Wrap-Up).* • *Students calculate and graph the volume of water available for human use (step 5).* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and calculate the impact that this growth will cause and possible solutions.* **Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS3-1)** • *Students determine and graph the proportion of Earth's available fresh water (Warm Up and Wrap Up).* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions.(Extension)* ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Students read U.S. Geological Survey report 'Estimated Use of Water in the United States in 2010' and analyze how*

technologies to protect and supply fresh water.	*resource (Wrap-Up).* • *Students investigate and share knowledge of technologies to protect and supply fresh water.*	*water is used in the United States. (Extension used in CA).*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-2), (5-ESS3-1)

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2), (5-ESS3-1)

W.5.9.a,b Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-2), (5-ESS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-2), (5-ESS3-1)

MP.4 Model with mathematics. (5-ESS2-2), (5-ESS3-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

A Drop in the Bucket correlates well to 5th grade NGSS Performance Expectations 5-ESS2-2 *as written*, but correlations to CCSS *could* be made and all NGSS correlations enhanced if modifications in grey are made. This would also help correlate this activity to an additional PE - 5-ESS3-1. Gray areas suggest revising activity lay-out:

Warm-up – Keep as is with students estimating proportion of potable water on Earth.

Part I: Water on Planet Earth would have students doing the current activity, but would also include reading the latest version of the USGS Fact Sheet *'Estimated Use of Water in the United States'* and analyzing how water is used in different parts of the United States. This is loosely referenced in the current activity extensions, but works so well as part of the activity!

Part II: Global Water Distribution would have students start by trying to estimate the volume of potable water available on Earth per person – This has great math potential, if students are asked to explain how they arrived at their estimates based on the available information in the activity to this point. Students would do the latter part of the existing activity as written – It just changes the emphasis from Earth to human allocations and opens the door to having students research and identify areas of the globe where water is in short supply. This is currently an extension, but would add greatly to the depth of knowledge gained by integrating it into the activity.

Part III: ActionEducation would incorporate other currently listed extensions into the activity by having students do the research on projected worldwide population trends at different points in the future, then discussing and calculating the potential impacts to global water supplies available for human use – and the potential ramifications for all other life on the planet. Students would then develop the television commercial or other presentation outlining reasons why water is a limited and also renewable resource in the extensions.

I also suggest having students make an engineering connection by investigating and share knowledge of technologies to protect and supply fresh water either as part of the ActionEducation component or as a suggested extension.

Project WET: A Drop in the Bucket

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 257
Brief Lesson Description: By estimating and calculating the percentage of available fresh water on Earth, students understand that this resource must be used and managed carefully.		
Performance Expectation: MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-ESS3-4)** • *Students read U.S. Geological Survey report 'Estimated Use of Water in the United States in 2010' and analyze how water is used in the United States.* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions. (Extension)* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and discuss the impact that this growth will cause and possible solutions. (Extension)* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and calculate the impact that this growth will cause and possible solutions.* • *Students develop a television commercial or other presentation outlining reasons why water is a limited and also renewable resource (Wrap-Up).* • *Students investigate and share knowledge of technologies to protect and supply fresh water.*	**ESS3.C: Human Impacts on Earth Systems** Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-4)** • *Students determine and graph the proportion of Earth's available fresh water (Warm Up and Wrap Up).* • *Students calculate and graph the volume of water available for human use (step 5).* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions. (Extension)* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and discuss the impact that this growth will cause and possible solutions. (Extension)* • *Students investigate and share knowledge of technologies to protect and supply fresh water.*	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-ESS3-4)** • *Students calculate and graph the volume of water available for human use (step 5).* • *Students read U.S. Geological Survey report 'Estimated Use of Water in the United States in 2010' and analyze how water is used in the United States.* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions. (Extension)* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and discuss the impact that this growth will cause and possible solutions. (Extension)* ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ESS3-4)** • *Students determine and graph the proportion of Earth's available fresh water (Warm-Up and Wrap-Up).* • *Students read U.S. Geological Survey report 'Estimated Use of Water in the United States in 2010' and analyze how water is used in the United States.* • *Students calculate and graph the volume of water available for human use (step 5).* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions. (Extension)* • *Students investigate and share knowledge of*

		technologies to protect and supply fresh water. ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. **(MS-ESS3-4)** • *Students calculate and graph the volume of water available for human use (step 5).* • *Students read U.S. Geological Survey report 'Estimated Use of Water in the United States in 2010' and analyze how water is used in the United States.* • *Students identify areas of the globe where water is limited, plentiful or in excess and discuss the geographical and climatic qualities contributing to these conditions. (Extension)* • *Students do an Internet search to determine the world population projections for 2025 and 2050 and discuss the impact that this growth will cause and possible solutions. (Extension)*

NGSS Common Core Connections:
ELA/Literacy –
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-4)
WHST.6-8.1 Write arguments focused on discipline content. (MS-ESS3-4)
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-4)
Mathematics –
6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-4)
7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-ESS3-4)

Connections to other Common Core Standards at this Grade Level: SL.6-8.4, 6.RP.3c; 7.NS.3; 7.RP.2

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena.
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. • Collect data about the performance of a proposed object, tool, process or system under a range of conditions.

Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

A Drop in the Bucket correlates to most dimensions of the MS NGSS Performance Expectation MS-ESS3-4 *as written*, but not to most of the connecting CCSS. Correlations to the CCSS *could* be made and all NGSS correlations enhanced if modifications in grey are made. Gray areas suggest revising activity lay-out:

Warm-up – Keep as is with students estimating proportion of potable water on Earth.

Part I: Water on Planet Earth would have students doing the current activity, but would also include reading the latest version of the USGS Fact Sheet *'Estimated Use of Water in the United States'* and analyzing how water is used in different parts of the United States. This is loosely referenced in the current activity extensions, but works so well as part of the activity!

Part II: Global Water Distribution would have students start by trying to estimate the volume of potable water available on Earth per person – This has great math potential, if students are asked to explain how they arrived at their estimates based on the available information in the activity to this point. Students would do the latter part of the existing activity as written – It just changes the emphasis from Earth to human allocations and opens the door to having students research and identify areas of the globe where water is in short supply. This is currently an extension, but would add greatly to the depth of knowledge gained by integrating it into the activity.

Part III: ActionEducation would incorporate other currently listed extensions into the activity by having students do the research on projected worldwide population trends at different points in the future, then discussing and calculating the potential impacts to global water supplies available for human use – and the potential ramifications for all other life on the planet. Students would then develop the television commercial or other presentation outlining reasons why water is a limited and also renewable resource in the extensions.

I also suggest having students make an engineering connection by investigating and share knowledge of technologies to protect and supply fresh water either as part of the ActionEducation component or as a suggested extension.

A Drop in the Bucket also correlates to some aspects of the NGSS Performance Expectation MS-ESS3-3 - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment and doesn't connect at all with other dimensions, but with the suggested alignments in gray and revising of activity flow, I could see teachers using this activity as a Secondary support to investigate this PE and connecting Engineering PEs.

Project WET: Germ Busters

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: **Pre K-2**	**Molecules to Organisms: Structures and Processes**	**Project WET Guide, Page #:** Guide 2.0, p. 57
Brief Lesson Description: Students learn a song to correctly practice hand washing, as well as other strategies for staying healthy.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA
NGSS Common Core Connections: ***ELA/Literacy – NA*** ***Mathematics – NA*** **Connections to other Common Core Standards at this Grade Level:** SL.K-1.2, SL.K-2.3, W.K.2		

Additional SEP Connections: Grades K-2	
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. • Make predictions based on prior experiences.

Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Systems and System Models	Systems and System Models: Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.

Correlation Comments	**Correlator Initials:** ELC
This activity does not have any NGSS PEs that go along with it, but several Common Core ELA correlations do exist. In addition, several SEPs and CCCs for NGSS do match up, so I've included them here. I highlighted the SEP about Analyzing data in which students would make predictions. That would be an easy tweak to this activity to ask them what they think might happen during the Warm Up and would support good Nature of Science practices for students to focus more on the science portion of the activity.	

Project WET: Germ Busters

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: Grades 3-5	Molecules to Organisms: Structures and Processes	Project WET Guide, Page #: Guide 2.0, p. 57
Brief Lesson Description: Students learn a song to correctly practice hand washing, as well as other strategies for staying healthy.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA

NGSS Common Core Connections:

ELA/Literacy – NA

Mathematics – NA

Connections to other Common Core Standards at this Grade Level:
SL.3-4.3

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

Correlation Comments	**Correlator Initials:** ELC
This activity does not have any NGSS PEs that go along with it, but it might lead to 3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. I would think (based on current science standards in my own state), that bacteria, viruses and other “germs” would be beyond the scope of 3rd grade science in which all other emphasis has been about plants and animals/humans. So, not sure we even want to consider making the connection here. In addition, several SEPs and CCCs for NGSS do match up, so I’ve included them here. I highlighted the SEPs about making predictions about what would happen if a variable changed. What if you washed, but not for long enough? What would happen if you washed without soap? What would happen if some bacteria (germs) did remain on the skin? Would that make us sick? That would be an easy tweak to this activity, to talk about the effects of inadequate hand washing and would support good Nature of Science practices for students to focus more on the science portion of the activity. It would also lead to the LS NGSS about Biological Evolution too. I would only recommend this for the Grades 3-5 age range and not for the K-2 (I had another suggestion for K-2☺).	

Project WET: Get the Ground Water Picture

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 2	Earth's Systems/ Matter and its Interactions	Project WET Guide, Page #: Guide 2.0, p. 143
Brief Lesson Description: Students learn about basic ground water principles as they create their own geologic cross section or Earth window.		
Performance Expectation: 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.		
Performance Expectation: 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Planning and Carrying Out Investigations Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. **(2-PS1-1)** • *Students write a brief description on what they think happens to water after it seeps into the ground. (Warm-up)* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.* • *Students predict the rate they think water will flow through each material (fastest to slowest)* • *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.* • *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.* • *Students observe melting of a frozen 237 ml (1 cup) sample of each material.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* **Obtaining, Evaluating, and Communicating Information** Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. **(2-ESS2-3)** • *Students write a brief description on what they think happens to water after it seeps into the ground. (Warm-up)* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students revise their original descriptions on what they think happens to water after it seeps into the ground.* • *Students research examples of liquid and/or solid underground water sources.*	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. **(2-ESS2-3)** • *Students write a brief description on what they think happens to water after it seeps into the ground. (Warm-up)* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.* • *Students predict the rate they think water will flow through each material (fastest to slowest)* • *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.* • *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.* • *Students observe melting of a frozen 237 ml (1 cup) sample of each material.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students revise their original descriptions on what they think happens to water after it seeps into the ground.* • *Students research examples of liquid and/or solid underground water sources.* **PS1.A: Structure and Properties of Matter** Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. **(2-PS1-1)** • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.* • *Students predict the rate they think water*	**Patterns** Patterns in the natural world and human designed can be observed. **(2-ESS2-3), (2-PS1-1)** • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students revise their original descriptions on what they think happens to water after it seeps into the ground.*

	will flow through each material (fastest to slowest) • *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.* • *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.* • *Students observe melting of a frozen 237 ml (1 cup) sample of each material.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students research examples of liquid and/or solid underground water sources.*	

NGSS Common Core Connections:

ELA/Literacy –

W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS2-3)

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS2-3), (2-PS1-1)

Mathematics –

MP.4 Model with mathematics. (2-PS1-1)

2.MD.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-PS1-1)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).

Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Decide when to use qualitative vs. quantitative data. • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. • Use quantitative data to compare two alternative solutions to a problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Construct an argument with evidence to support a claim. • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Systems and System Models: Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.

Energy and Matter	Energy and Matter: Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.
Structure and Function	Structure and Function: Students observe the shape and stability of structures of natural and designed objects are related to their function(s).
Stability and Change	Stability and Change: Students observe some things stay the same while other things change, and things may change slowly or rapidly.
Structure and Function	Structure and Function: Students observe the shape and stability of structures of natural and designed objects are related to their function(s).

Correlation Comments	**Correlator Initials:** DBB

Get the Ground Water Picture Part I correlates well to the 2nd Grade NGSS Performance Expectation 2-ESS2-2 *as written,* but not the connecting CCSS. The modifications in gray enhance existing elements in the activity and will strengthen correlation to all dimensions of 2-ESS2-2 ***and*** 2-PS1-1 and all connecting CCSS for both PEs. An outline of suggested modifications and flow for re-alignment is below.

Warm-up: Envisioning Underground Water Flow

- *Students observe water as it is poured on soil in the schoolyard, garden bed or pot.*
- *Students write a brief description on what they think happens to water after it seeps into the ground. (K-2 Warm-up)*

Part I: Investigating Underground Water and Geologic Interactions

- *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.*
- *Students predict the rate they think water will flow through each material (fastest to slowest)*
- *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.*
- *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.*
- *Students observe melting of a frozen 237 ml (1 cup) sample of each material.*
- *Students use grade appropriate math and graphs to compare the results of their investigations.*
- *Students revise their original descriptions on what they think happens to water after it seeps into the ground.*
- *Students research examples of liquid and/or solid underground water sources.*

Project WET: Get the Ground Water Picture

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	Earth's Systems/ Matter and its Interactions	Project WET Guide, Page #: Guide 2.0, p. 143
Brief Lesson Description: Students learn about basic ground water principles as they create their own geologic cross section or Earth window.		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Students write a brief description on what they think happens to water after it seeps into the ground. (Warm-up)* • *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students revise their original descriptions on what they think happens to water after it seeps into the ground.* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials, such as gravel, sand and clay. (Part I).* • *Students engage in a ground water movement simulation to show how different materials affect water movement.* • *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.* • *Students compare the results of their investigations using graphs.* • *Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • *Students investigate different materials*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. **(5-ESS2-1)** • *Students write a brief description on what they think happens to water after it seeps into the ground. (Warm-up)* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.* • *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.* • *Students observe melting of a frozen 237 ml (1 cup) sample of each material.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials, such as gravel, sand and clay. (Part I).* • *Students engage in a ground water movement simulation to show how different materials affect water movement.* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1), (5-ESS3-1)** • *Students write a brief description on what they think happens to water after it seeps into the ground. (Warm-up)* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.* • *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.* • *Students observe melting of a frozen 237 ml (1 cup) sample of each material.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students revise their original descriptions on what they think happens to water after it seeps into the ground.* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials, such as gravel, sand and clay. (Part I).* • *Students engage in a ground water movement simulation to show how different materials affect water movement.* • *Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells.* • *Students research for historical issues or perspectives related to groundwater sources in their community or state: i.e, legends, contamination, overuse, ownership, etc.* • *Students interview a guest speaker who studies, drills or manages groundwater resources.*

found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc. • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students revise their original descriptions on what they think happens to water after it seeps into the ground.* • *Students research examples of liquid and/or solid underground water sources.* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials, such as gravel, sand and clay. (Part I).* • *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.* • *Students compare the results of their investigations using graphs.* • *Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells.* • *Students research for historical issues or perspectives related to groundwater sources in their community or state* • *Students interview a guest speaker who studies, drills or manages groundwater resources.* • *Visit a local well site and survey the area for possible pollution sources in the vicinity of the well.*	*students and towns dependent on wells.* • *Students research for historical issues or perspectives related to groundwater sources in their community or state* • *Students interview a guest speaker who studies, drills or manages groundwater resources.* • *Visit a local well site and survey the area for possible pollution sources in the vicinity of the well.*	***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Students write a brief description on what they think happens to water after it seeps into the ground. (Warm-up)* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.* • *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.* • *Students observe melting of a frozen 237 ml (1 cup) sample of each material.* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials, such as gravel, sand and clay. (Part I).* • *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.* • *Students compare the results of their investigations using graphs.* • *Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells.* • *Students research for historical issues or perspectives related to groundwater sources in their community or state:* • *Students interview a guest speaker who studies, drills or manages groundwater resources.* • *Visit a local well site and survey the area for possible pollution sources in the vicinity of the well.*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1),(5-ESS3-1)

RI.5.9.a,b Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)

W.5.9.a,b Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS3-1)

MP.4 Model with mathematics. (5-ESS2-1), (5-ESS3-1)

5.G.2 Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

Connections to other Common Core Standards at this Grade Level: 5.MD.1

Additional SEP Connections: Grades 3-5

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Structure and Function: Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions

Correlation Comments	**Correlator Initials:** DBB

Get the Ground Water Picture Part I & ll correlate well to the intended content of the 5th Grade NGSS Performance Expectation 5-ESS2-1 and 5-ESS3-1, but has weak correlation to a number of the NGSS dimension elements and none to the majority of connecting CCSS *as written*. The modifications in gray enhance existing elements in the activity and add additional actions to strengthen correlation to all dimensions and all connecting CCSS for both PEs. An outline of suggested modifications and flow for re-alignment is below.

Warm-up: Envisioning Underground Water Flow

- *Students observe water as it is poured on soil in the schoolyard, garden bed or pot.*
- *Students write a brief description on what they think happens to water after it seeps into the ground. (K-5 Warm-up)*

Part I: Investigating Underground Water and Geologic Interactions

- *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.*
- *Students predict the rate they think water will flow through each material (fastest to slowest)*
- *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.*
- *Students observe melting of a frozen 237 ml (1 cup) sample of each material.*
- *Students use grade appropriate math and graphs to compare the results of their investigations.*
- *Students revise their original descriptions on what they think happens to water after it seeps into the ground. (K-5)*
- *Students research examples of liquid and/or solid underground water sources.*

Part II: Simulating Underground Water and Geologic Interactions

- *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials, such as gravel, sand and clay. (Part I).*
- *Students engage in a ground water movement simulation to show how different materials affect water movement.*
- *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.*

- *Students compare the results of their investigations using graphs.*

Part III: Connecting Groundwater Science to Reality

- Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells.
- Students research for historical issues or perspectives related to groundwater sources in their community or state: i.e, legends, contamination, overuse, ownership, etc.
- Students interview a guest speaker who studies, drills or manages groundwater resources.
- Visit a local well site and survey the area for possible pollution sources in the vicinity of the well.

Resources:

USGS: Water Science for Schools – Groundwater: https://water.usgs.gov/edu/wugw.html
USGS: Map of the Principal Aquifers of the United States: http://water.usgs.gov/ogw/aquifer/map.html
USGS Aquifer diagram: http://water.usgs.gov/edu/earthgwaquifer.html

Project WET: Get the Ground Water Picture

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Earth's Systems/ Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 143
Brief Lesson Description: Students learn about basic ground water principles as they create their own geologic cross section or Earth window.		
Performance Expectation: MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		
Performance Expectation: MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **(MS-ESS3-1)** Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • *Students develop a diagram and/or description of how they think water is distributed in an underground aquifer.* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay).* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials. (Part I).* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students revise their diagram and/or description of how they think water is distributed in an underground aquifer.* • *Students use data to construct a visual well log (Part III).* • *Students develop an aquifer diagram and identify the parts of a ground water system (Part III, step 5)* • *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)* • *Students determine when additional data are needed to draw valid conclusions (Part*	**ESS3.A: Natural Resources** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. **(MS-ESS3-1)** • *Students develop a diagram and/or description of how they think water is distributed in an underground aquifer.* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay).* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials. (Part I).* • *Students revise their diagram and/or description of how they think water is distributed in an underground aquifer.* • Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells. • Students research for historical issues or perspectives related to groundwater sources in their community or state: i.e, legends, contamination, overuse, ownership, etc. • *Students develop an aquifer diagram and identify the parts of a ground water system (Part III, step 5)* • *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)* • *Students research solutions to mitigate the*	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-ESS3-1), (MS-ESS3-3), (MS-ESS3-4)** • *Students develop a diagram and/or description of how they think water is distributed in an underground aquifer.* • *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay).* • *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials. (Part I).* • *Students use grade appropriate math and graphs to compare the results of their investigations.* • *Students engage in a ground water movement simulation to show how different materials affect water movement.* • *Students revise their diagram and/or description of how they think water is distributed in an underground aquifer.* • *Students develop an aquifer diagram and identify the parts of a ground water system (Part III, step 5)* • *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)* • *Students research solutions to mitigate the groundwater issues identified in the aquifer diagram.* • *Students plan and conduct an investigation on the use of common aquifer materials to filter sediment and materials carried by water. (Extensions)* • *Students apply grade appropriate math*

III, steps 4 and 5).
- *Students research solutions to mitigate the groundwater issues identified in the aquifer diagram.*
- *Students apply grade appropriate math techniques to compare and rank the water filtering capability of common aquifer materials based on evidence from their own investigations and additional research.*
- *Students develop a criteria rubric to evaluate the application of current ground water protection and management strategies to mitigate a local or state ground water issues, including criterion comparing cost, environmental impact and viability of use in the local setting.*
- *Students develop a plan to mitigate a local or regional groundwater issue.*

Engaging in Argument from Evidence
Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-ESS3-4)**
- *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)*
- *Students determine when additional data are needed to draw valid conclusions (Part III, steps 4 and 5).*
- *Students research solutions to mitigate the groundwater issues identified in the aquifer diagram.*
- *Students develop a criteria rubric to evaluate the application of current ground water protection and management strategies to mitigate a local or state ground water issues, including criterion comparing cost, environmental impact and viability of use in the local setting.*
- *Students develop an argument from evidence on the application of current ground water protection and management strategies to mitigate a local or state ground water issue.*

groundwater issues identified in the aquifer diagram.
- *Students investigate ground water use and contamination issues in their community, region and/or state.*
- *Students investigate current strategies used in the management and protection of ground water resources, including use of storm water as a source to replenish groundwater aquifers.*
- *Students invite a groundwater manager to discuss local or regional groundwater issues.*
- *Students develop a plan to mitigate a local or regional groundwater issue.*

ESS3.C: Human Impacts on Earth Systems
Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)**
Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-4)**
- Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells.
- Students research for historical issues or perspectives related to groundwater sources in their community or state: i.e, legends, contamination, overuse, ownership, etc.
- Students interview a guest speaker who studies, drills or manages groundwater resources.
- *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)*
- *Students research solutions to mitigate the groundwater issues identified in the aquifer diagram.*
- *Students investigate ground water use and contamination issues in their community, region and/or state.*
- *Students investigate current strategies used in the management and protection of ground water resources, including use of storm water as a source to replenish groundwater aquifers.*
- *Students invite a groundwater manager to discuss local or regional groundwater issues.*
- *Students develop a plan to mitigate a local or regional groundwater issue.*

techniques to compare and rank the water filtering capability of common aquifer materials based on evidence from their own investigations and additional research.
- *Students develop a criteria rubric to evaluate the application of current ground water protection and management strategies to mitigate a local or state ground water issues, including criterion comparing cost, environmental impact and viability of use in the local setting.*
- *Students develop a plan to mitigate a local or regional groundwater issue.*

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ESS3-1), (MS-ESS3-4)**
The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-3)**
- *Students use data to construct a visual well log (Part III).*
- *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)*
- *Students research solutions to mitigate the groundwater issues identified in the aquifer diagram.*
- *Students investigate ground water use and contamination issues in their community, region and/or state.*
- *Students investigate current strategies used in the management and protection of ground water resources, including use of storm water as a source to replenish groundwater aquifers.*
- *Students invite a groundwater manager to discuss local or regional groundwater issues.*
- *Students develop a criteria rubric to evaluate the application of current ground water protection and management strategies to mitigate a local or state ground water issues, including criterion comparing cost, environmental impact and viability of use in the local setting.*
- *Students develop a plan to mitigate a local or regional groundwater issue.*

		……………………………………………………………………… ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. **(MS-ESS3-4)** • *Students use data to construct a visual well log (Part III).* • *Students develop an aquifer diagram and identify the parts of a ground water system (Part III, step 5)* • *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)* • *Students determine when additional data are needed to draw valid conclusions (Part III, steps 4 and 5).* • *Students investigate ground water use and contamination issues in their community, region and/or state.* • *Students investigate current strategies used in the management and protection of ground water resources, including use of storm water as a source to replenish groundwater aquifers.* • *Students develop a criteria rubric to evaluate the application of current ground water protection and management strategies to mitigate a local or state ground water issues, including criterion comparing cost, environmental impact and viability of use in the local setting.*

NGSS Common Core Connections:
ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1), (MS-ESS3-4)
WHST.6-8.1	Write arguments focused on discipline content. (MS-ESS3-4)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1), (MS-ESS3-4)

Mathematics –

Connections to other Common Core Standards at this Grade Level: RST.6-12.4; RST.6-12.7

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.

Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Structure and Function: Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

The content of Get the Ground Water Picture correlates well to the MS Grade NGSS Performance Expectation MS-ESS3-4*,* but has *weak correlation* PE MS-ESS3-3 and MS-ESS3-1 and to *most of the NGSS dimension elements and no correlation to the majority of connecting CCSS as written*. The modifications in gray enhance existing elements in the activity and add additional actions to strengthen correlation to all dimensions and all connecting Language Arts CCSS – *however,* the suggested Math components that will correlate to lower grades do not for this grade level.

The modifications will also open the door for teachers to extend the use of the activity with the MS Engineering Design PEs, though they will need to work with students to develop math and other additional content to support adequate correlation to these additional PEs.

Also highly suggest amending Charting Course for this activity to include '*Storm Water*' and all water quality testing activities.

There are a number of HS PEs that tie in well with the general content at the heart of this activity, but it does not meet the level of rigor – and definitely not the Math – needed to develop a correlation to the PEs below:
HS-ESS2-2. - Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.
HS-ESS3-1. - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards,

and changes in climate have influenced human activity.
*HS-ESS3-4.- Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.**
HS-ESS3-6.- Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

An outline of suggested modifications and flow for re-alignment is below.

Warm-up: Envisioning Underground Water Flow

- *Students develop a diagram and/or description of how they think water is distributed in an underground aquifer.*

Part I: Investigating Underground Water and Geologic Interactions

- *Students investigate different materials found underground (soil, rocks, pea gravel, sand, clay) by size, feel, color, hardness, etc.*
- *Students predict the rate they think water will flow through each material (fastest to slowest)*
- *Students measure the time it takes for 237 ml (1 cup) of water to flow through each material.*
- *Students observe melting of a frozen 237 ml (1 cup) sample of each material.*
- *Students use grade appropriate math and graphs to compare the results of their investigations.*

Part Il: Simulating Underground Water and Geologic Interactions

- *Students describe and diagram how they think pore-size between particles affects the movement of water moves through aquifer materials. (Part I).*
- *Students engage in a ground water movement simulation to show how different materials affect water movement.*
- *Students predict and observe how much water can be added to 237 ml (1 cup) of each material.*
- *Students use grade appropriate math and graphs to compare the results of their investigations.*
- *Students revise their diagram and/or description of how they think water is distributed in an underground aquifer.*

Part Ill: Connecting Groundwater Science to Reality

- Students investigate sources of groundwater in their community, region and/or state, including maps of known aquifers and students and towns dependent on wells.
- Students research for historical issues or perspectives related to groundwater sources in their community or state: i.e, legends, contamination, overuse, ownership, etc.
- Students interview a guest speaker who studies, drills or manages groundwater resources.
- Visit a local well site and survey the area for possible pollution sources in the vicinity of the well.

Part Il: Visualizing Groundwater Use & Issues

- *Students use data to construct a visual well log (Part III).*
- *Students develop an aquifer diagram and identify the parts of a ground water system (Part III, step 5)*
- *Students analyze possible effects on ground water based in interpretations of the well logs. (Part III, steps 4 and 5)*
- *Students determine when additional data are needed to draw valid conclusions (Part III, steps 4 and 5).*
- *Students research solutions to mitigate the groundwater issues identified in the aquifer diagram.*

Part Ill: Investigating Groundwater Overuse & Contamination Solutions

- *Students investigate ground water use and contamination issues in their community, region and/or state.*
- *Students plan and conduct an investigation on the use of common aquifer materials to filter sediment and materials carried by water. (Extensions)*
- *Students apply grade appropriate math techniques to compare and rank the water filtering capability of common aquifer materials based on evidence from their own investigations and additional research.*
- *Students investigate current strategies used in the management and protection of ground water resources, including use of storm water as a source to replenish groundwater aquifers.*

Part V: ActionEducation

- *Students invite a groundwater manager to discuss local or regional groundwater issues.*
- *Students develop a criteria rubric to evaluate the application of current ground water protection and management strategies to mitigate a local or state ground water issues, including criterion comparing cost, environmental impact and viability of use in the local setting.*
- *Students develop an argument from evidence on the application of current ground water protection and management strategies to mitigate a local or state ground water issues*
- *Students develop a plan to mitigate a local or regional groundwater issue.*

Resources:
USGS: Water Science for Schools – Groundwater: https://water.usgs.gov/edu/wugw.html
USGS: Map of the Principal Aquifers of the United States: http://water.usgs.gov/ogw/aquifer/map.html
USGS Aquifer diagram: http://water.usgs.gov/edu/earthgwaquifer.html
Charting Course: Water Quality Testing water is collected and analyzed for specific contaminants (bacteria, nitrates, arsenic and so forth).

Project WET: A Grave Mistake

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: 5</td><td></td><td>Project WET Guide, Page #:
Guide 2.0, p. 315</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students analyze data to solve a mystery and identify a potential polluter.</td></tr>
<tr><td colspan="3">Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</td></tr>
<tr><td>Science & Engineering Practice(s)</td><td>Disciplinary Core Idea(s)</td><td>Crosscutting Concept(s)</td></tr>
<tr><td>Obtaining, Evaluating, and Communicating Information
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)
• Students listen and record historical and medical data to locate an underground contaminant.
• Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).
• Students determine that insufficient data can lead to invalid conclusions (step 8).
• Students develop an argument based on evidence for the location of the underground contaminant.
• Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.</td><td>ESS3.C: Human Impacts on Earth Systems
Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)
• Students listen and record historical and medical data to locate an underground contaminant.
• Students develop an argument based on evidence for the location of the underground contaminant.
• Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.</td><td>Systems and System Models
A system can be described in terms of its components and their interactions.
(5-ESS3-1)
• Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).
• Student teams develop and apply a system to locate the source of the underground contaminant and the flow of the contaminant plume.
• Student teams compare strategies used to locate the source of the underground contaminant
• Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.
....
Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
Science findings are limited to questions that can be answered with empirical evidence.
(5-ESS3-1)
• Students listen and record historical and medical data to locate an underground contaminant.
• Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).
• Students determine that insufficient data can lead to invalid conclusions (step 8).
• Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.</td></tr>
</table>

NGSS Common Core Connections:
ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1)

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)

W.5.9.a,b Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. 5-ESS3-1)

MP.4 Model with mathematics. (5-ESS3-1)

Connections to other Common Core Standards at this Grade Level: 5.G.2

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

Correlation Comments	**Correlator Initials:** DBB

Revising the structure of A Grave Mistake and including the areas in gray as outlined below would align and correlate the first half of the activity well to the 5th grade NGSS Performance Expectations 5-ESS3-1 and corresponding CCSS**,** while also structuring the activity to build toward the PE alignments in the MS correlation document for this activity.

Suggest removing the existing Warm-up – We already use this model in 'Pucker Effect,' it is very teacher driven unless we instruct teachers to have students build the models, which then adds unnecessary complexity in materials to this activity – and I know of few teachers who use it. I suggest diving straight into the scenario and having kids record what they think will be relevant clues to solving the mystery, then discussing why they think so with peers.

Suggest removing the information regarding groundwater flow from the directions, but including the rest of the activity instructions as written – Let the students figure out the direction of flow based on the data, just as any scientist trying to locate and track an underground contaminant would have to do. See the MS correlation document for additional notes.

Below is a suggested outline to realign the activity:

Warm-up: The Scenario
- *Students listen and record historical and medical data to locate an underground contaminant.*
- *Students compare and discuss the information they recorded.*

Part I: Developing a System
- *Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).*
- *Students determine that insufficient data can lead to invalid conclusions (step 8).*

Part ll: Locating an Underground Contaminant
- *Student teams develop and apply a system to locate the source of the underground contaminant.*

- *Students develop an argument based on evidence for the location of the underground contaminant and the flow of the contaminant plume.*
- *Student teams compare strategies used to locate the source of the underground contaminant*

Part III: Understanding Arsenic

- Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.
- *Students investigate medical symptoms and treatments for arsenic poisoning and discuss why the wife did not show signs of poisoning. (Extension)*
- *Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)*

Part IV: ActionEducation

- *Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap Up).*

Books: 'In the Name of the Rose'; 'Arsenic and Old Lace'

Websites: http://www.smithsonianmag.com/science-nature/arsenic-and-old-graves-civil-war-era-cemeteries-may-be-leaking-toxins-180957115/

http://www.nrdc.org/issues - Great list of current issues derived from past solutions to needs.

Project WET: A Grave Mistake

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: MS</td><td>Earth and Human Activity/ Ecosystems: Interactions, Energy, and Dynamics</td><td>Project WET Guide, Page #:
Guide 2.0, p. 315</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students analyze data to solve a mystery and identify a potential polluter.</td></tr>
<tr><td colspan="3">Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.</td></tr>
<tr><td colspan="3">Performance Expectation: MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.</td></tr>
<tr><th>Science & Engineering Practice(s)</th><th>Disciplinary Core Idea(s)</th><th>Crosscutting Concept(s)</th></tr>
<tr>
<td>Constructing Explanations and Designing Solutions
Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)
• Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).
• Student teams develop and apply a system to locate the source of the underground contaminant.
• Student teams compare strategies used to locate the source of the underground contaminant
• Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)
• Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap Up).

Engaging in Argument from Evidence
Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)
• Students listen and record historical and medical data to locate an underground contaminant.
• Students determine that insufficient data can lead to invalid conclusions (step 8).
• Students develop an argument based on evidence for the location of the underground contaminant and the flow of the contaminant plume.</td>
<td>ESS3.C: Human Impacts on Earth Systems
Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
• Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.
• Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)
• Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap-Up).

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)
• Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.
• Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)</td>
<td>Cause and Effect
Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
• Students listen and record historical and medical data to locate an underground contaminant.
• Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).
• Students determine that insufficient data can lead to invalid conclusions (step 8).
• Students develop an argument based on evidence for the location of the underground contaminant and the flow of the contaminant plume.
• Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.
• Students investigate medical symptoms and treatments for arsenic poisoning and discuss why the wife did not show signs of poisoning. (Extension)
• Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)
• Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap-Up).</td>
</tr>
</table>

• *Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.* • *Students investigate medical symptoms and treatments for arsenic poisoning and discuss why the wife did not show signs of poisoning. (Extension)* • *Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap-Up).* .... ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** Science disciplines share common rules of obtaining and evaluating empirical evidence. **(MS-LS2-4)** • *Students listen and record historical and medical data to locate an underground contaminant.* • *Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).* • *Student teams develop and apply a system to locate the source of the underground contaminant.* • *Students develop an argument based on evidence for the location of the underground contaminant and the flow of the contaminant plume.* • *Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.* • *Students investigate medical symptoms and treatments for arsenic poisoning and discuss why the wife did not show signs of poisoning. (Extension)*	• *Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap-Up).*	**Stability and Change** Small changes in one part of a system might cause large changes in another part. **(MS-LS2-4)** • *Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.* • *Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)* • *Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap-Up).* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-3)** • *Students listen and record historical and medical data to locate an underground contaminant.* • *Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.* • *Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)* • *Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap-Up).*

NGSS Common Core Connections:
ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4)
RI.8.8	Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4)
WHST.6-8.1	Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS2-4)

Connections to other Common Core Standards at this Grade Level: RH.6-12.7; RST.6-12.4; SL.6-12.1; SL.6-7.2

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.

Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

The elements of A Grave Mistake correlate well to MS grade NGSS Performance Expectations MS-ESS3-3 *as written*, **if** the activity is revised to integrate many of the existing Extensions ***and*** the modifications in grey are included to strengthen alignment to the NGSS dimensions and correlations to the connecting CCSS, which are pretty much nonexistent as written. This will also allow correlations to an additional PE - MS-LS2-4

Suggest removing the existing Warm-up – We already use this model in 'Pucker Effect,' it is very teacher driven unless we instruct teachers to have students build the models, which then adds unnecessary complexity in materials to this activity – and I know of few teachers who use it. I suggest diving straight into the scenario and having kids record what they think will be relevant clues to solving the mystery, then discussing why they think so with peers.

Suggest removing the information regarding groundwater flow from the directions, but including the rest of the activity instructions as written – Let the students figure out the direction of flow based on the data, just as any scientist trying to locate and track an underground contaminant would have to do.

The current extensions coupled with the gray shaded modifications add more student driven investigation and research that is needed to increase the content depth of the activity and correlate to the connecting CCSS standards. As I've been repeatedly 'fact checked' on this activity, why not have just as skeptical Middle school students do the same.

Also suggest using the existing 'Past Solution, Current Problem' in the existing activity Wrap-up as an ActionEducation component that will have student teams expanding on this theme to generate their own investigations and presentations backed by sources and further supporting the build up to the Engineering aspect of PE MS-ESS3-3.

Below is a suggested outline to realign the activity:

Warm-up: The Scenario
- *Students listen and record historical and medical data to locate an underground contaminant.*

Part I: Developing a System
- *Students plot data on a map to determine a source of arsenic contamination (steps 4 and 11).*
- *Students determine that insufficient data can lead to invalid conclusions (step 8).*

Part lI: Locating an Underground Contaminant
- *Student teams develop and apply a system to locate the source of the underground contaminant and the flow of the contaminant plume.*
- *Students develop an argument based on evidence for the location of the underground contaminant.*
- *Student teams compare strategies used to locate the source of the underground contaminant*
- Students investigate the scenario presented in the activity and construct an argument to support or refute the basis of the phenomenon presented in this activity.

Part III: Understanding Arsenic
- *Students investigate medical symptoms and treatments for arsenic poisoning and discuss why the wife did not show signs of poisoning. (Extension)*
- *Students investigate the condition of ground water in their community or region and the techniques used to monitor and minimize its impact. (Extensions)*

Part IV: ActionEducation
- *Students investigate a current example illustrating the idea: "Past solutions-present problems" and develop a presentation citing research and includes examples of techniques used to monitor and minimize its impact. (Wrap Up)*

Additional Resources

Books: 'In the Name of the Rose'; 'Arsenic and Old Lace'

Websites: http://www.smithsonianmag.com/science-nature/arsenic-and-old-graves-civil-war-era-cemeteries-may-be-leaking-toxins-180957115/

http://www.nrdc.org/issues - Great list of current issues derived from past solutions to needs.

Project WET: Great Water Journeys

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	**From Molecules to Organisms: Structures and Processes**	**Project WET Guide, Page #:** Guide 1.0, p. 246
Brief Lesson Description: Students locate some significant water journeys, using a global map and a set of clue cards.		
Performance Expectation: MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-LS1-4)**	**LS1.B: Growth and Development of Organisms** Animals engage in characteristic behaviors that increase the odds of reproduction. **(MS-LS1-4)** Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. **(MS-LS1-4)** • *Students play a game by reading clues about water journeys and deciding who is making the journey. (Step 3, The Activity: Journeys C, D, and F, specifically)*	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **(MS-LS1-4)** • *Students sketch the path they think the subject of their summary cards traveled, which may or may not be the most direct path. What might account for the difference in paths? (Steps 5 & 6, The Activity).*
NGSS Common Core Connections: ***ELA/Literacy –*** **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6) **RI.6.8** Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MSLS1-3), (MS-LS1-4) **WHST.6-8.1** Write arguments focused on discipline content. (MS-LS1-3), (MS-LS1-4) ***Mathematics –*** **6.SP.A.2** Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. *(MSLS1-4),(MS-LS1-5)* **6.SP.B.4** Summarize numerical data sets in relation to their context. *(MS-LS1-4), (MS-LS1-5)*		

Additional SEP Connections: Grades 6-8	
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.

Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** ELC
Great Water Journeys is a very strong social studies activity, but also applies to this NGSS PE for Journeys C (turtles), D (gray whales), F (coconuts) and I (zebra mussels). The remaining clue cards for each journey have either a social studies emphasis or Journey E was about the Gulf Stream, but I couldn't put an Earth Science NGSS with this for this grade level. Since the NGSS PE was really about using argument and empirical evidence, this activity will really need to be tweaked to include the use of argument. Argument is having students make a claim and provide the evidence, so perhaps they can do this as part of Step 4 of The Activity and supplement their clue card information with more info about how these animals and plants survive through their behavior and plant structures. The activity is really about tracing their journeys through water, but it would be easy to add in this piece too as part of the activity in the Wrap Up. I've highlighted in gray the parts of the PE and SEPs that would be addressed, IF the argument piece were included.	

Project WET: H_2Olympics

* Activities are correlated <u>as written.</u> However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: Upper Elementary	**Topic: Adhesion and Cohesion**	**Project WET Guide, Page #:** Guide 2.0, p. 13
Brief Lesson Description: Students compete in a Water Olympics to investigate two properties of water, adhesion and cohesion.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA

NGSS Common Core Connections:

ELA/Literacy – NA

Mathematics – NA

Connections for H_2Olympics to other Common Core Standards at this Grade Level:
RI.3-4.3

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships • Identify scientific (testable) and non-scientific (non-testable) questions.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	**Correlator Initials:** ELC

There were no Performance Expectations matched at the Upper Elementary Level for this activity.
The idea of cohesion and adhesion of water is key to understanding some life science information, such as how trees can get water high up in the trunk and how soils hold on to water, but isn't really included in the NGSS. It is too specific and not a broad enough concept to be addressed in NGSS.

This activity does lead directly to 5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water. *How* do they get the water they need? Cohesion of water molecules and Adhesion between water and xylem tubes. Perhaps we could even make that connection for teachers as another extension or mention at the end of the activity?

Post Review Comments: After looking at both reviewers' comments and the activity again, I tried to correlate to 5-PS1-3. It's a bit of a tough call. It seems that the activity fits with the three dimensions, but the PE is aimed at identification of substances from their properties, which the activity is not. It showcases cohesion/adhesion as properties of water (a known substance). This activity is a great example of carrying out an investigation and making observations, but I think Erica is right that it doesn't really correlate with the NGSS using our correlation methods.

As for 5-LS1-1, I would say the concepts in this activity are secondary to that. Yes, it is the mechanism that allows water to move through plants, but that standard is focused on the process/system of photosynthesis. Since this activity does not directly involve plants I think it is too far removed to correlate.

Sadly, no correlations.

Project WET: Hangin' Together

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: MS</td><td>Topic: Properties of Water</td><td>Project WET Guide, Page #:
Guide 2.0, p. 19</td></tr>
<tr><td colspan="3">Brief Lesson Description: What has a tough skin, can make a mountain of sugar disappear, keeps elephants cool and cracks giant boulders? Students investigate four unique properties of water, important for life on Earth.</td></tr>
<tr><td colspan="3">Performance Expectation: MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.</td></tr>
<tr><td colspan="3">Performance Expectation: MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</td></tr>
<tr><td>Science & Engineering Practice(s)</td><td>Disciplinary Core Idea(s)</td><td>Crosscutting Concept(s)</td></tr>
<tr><td>Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test,
and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena. (MS-PS1-1), (MS-PS1-4)
• Students role play as water molecules, displaying positive and negative poles and hydrogen bonding (Part I)
• Students role play as water molecules, representing behavior of water (surface tension, dissolving, evaporating, freezing). (Part III)
• Students create a model of a water molecule with balloons, labeling electrons and protons to demonstrate how hydrogens and oxygen bond. (Extension)</td><td>PS1.A: Structure and Properties of Matter
Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)
• Students role play as water molecules, displaying positive and negative poles and hydrogen bonding (Part I)
• Students create a model of a water molecule with balloons, labeling electrons and protons to demonstrate how hydrogens and oxygen bond. (Extension)
Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
• Students do a simple lab (Student Activity card) and role play about the evaporation of and freezing of water (Parts II and III)
In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
• Students do a simple lab (Student Activity card) and role play about the evaporation of and freezing of water (Parts II and III)
Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
(MS-PS1-1)
• Students do a simple lab (Student Activity card) and role play about the evaporation of and freezing of water (Parts II and III)

The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)</td><td>Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
• Students do a simple lab (Student Activity card) and role play about the freezing of water (Parts II and III)

Scale, Proportion, and Quantity
Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.(MS-PS1-1)
• Students role play as water molecules, representing behavior of water (surface tension, dissolving, evaporating, freezing). (Part III)
• Students create a model of a water molecule with balloons, labeling electrons and protons to demonstrate how hydrogens and oxygen bond. (Extension)</td></tr>
</table>

	PS3.A: Definitions of Energy The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. **(secondary to MSPS1-4)** The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. **(secondary to MS-PS1-4)**	

NGSS Common Core Connections:
ELA/Literacy –
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram,
model, graph, or table). (*MS-PS1-1*),(MS-PS1-2),(*MS-PS1-4),(MS-PS1-5)*
Mathematics –
MP.2 Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5)
MP.4 Model with mathematics. (*MS-PS1-1*),(MS-PS1-5)
6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-PS1-1),(MS-PS1-2)*,(MS-PS1-5)
6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below
zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world
contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)
8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times
as much one is than the other. (*MS-PS1-1)*

Connections to other Common Core Standards at this Grade Level:
RI.6.7, RST.6-8.3, SL.6-7.2, SL.6.4, SL.6-8.1c

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions: • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. (Only if we don't give it all away in the Warm Up) • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation using models or representations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Energy and Matter	Energy and Matter: Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.

Correlation Comments	**Correlator Initials:** ELC
The Extension for Hangin' Together leads right to HS-PS1-1 about valence electrons and MS-PS1-1 for the Extension was a perfect match. ☺ The Extension also leads to MS-PS3-2 and HS-PS3-2. 6.NS.C.5 in the Math CCSS also seemed a perfect match for the Extension. Could we consider making the Extension part of the activity?	

Project WET: Healthy Habits

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: **Grades 3-5**	**Topic**: Molecules to Organisms: Structures and Processes	**Page #:** Guide 2.0, p. 63
Brief Lesson Description: Students participate in a series of demonstrations and a game of tag to show how illness-causing bacteria and viruses can be spread by water.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA

NGSS Common Core Connections:

ELA/Literacy – NA

Mathematics – NA

Connections to other Common Core Standards at this Grade Level:
SL.4-5.1c

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

Correlation Comments	**Correlator Initials:** ELC

This activity does not have any NGSS PEs that go along with it, but it might lead to 3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms survive well, some survive less well, and some cannot survive at all. I would think (based on current science standards in my own state), that bacteria, viruses and other "germs" would be beyond the scope of 3rd grade science in which all other emphasis has been about plants and animals/humans. So, not sure we even want to consider making the connection here (This is the same note that I put for Germ Busters for this grade level).

In addition, several SEPs and CCCs for NGSS do match up, so I've included them here. I highlighted the SEPs about making predictions about what would happen if a variable changed. What if you washed, but not for long enough? What would happen if some bacteria (germs) did remain on the skin? Would that make us sick? What happens if we aren't in close contact with others? What if we are in smaller spaces with sick people—will we get sick too? In "The Common Cup", once the variable of using the same cup for everyone, changed, students stopped getting sick as much. That would be an easy tweak to this activity, to talk about the effects of inadequate hand washing and would support good Nature of Science practices for students to focus more on the science portion of the activity. It would also lead to the LS NGSS about Biological Evolution too. I would only recommend this for the Grades 3-5 age range—I have another suggestion for MS.

Project WET: Healthy Habits

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: **MS**	**From Molecules to Organisms:** Structures and Processes	**Project WET Guide, Page #:** Guide 2.0, p. 63
Brief Lesson Description: Students participate in a series of demonstrations and a game of tag to show how illness-causing bacteria and viruses can be spread by water.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA
NGSS Common Core Connections: ***ELA/Literacy – NA*** ***Mathematics – NA*** **Connections to other Common Core Standards at this Grade Level:** SL.6.1c, 6.NS.5		

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions. • that require sufficient and appropriate empirical evidence to answer.
Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena.
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings. Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation using models or representations.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Structure and Function: Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Correlation Comments	**Correlator Initials:** ELC

This activity does not directly tie with any MS PEs, but several SEPs and CCCs for NGSS do match up, so I've included them here.

Another good MS Extension for this activity might be to research or discuss the overuse of antibacterial soaps and hand sanitizers used in the US…once the importance of good handwashing is known, then we might want to focus on those who are "germaphobes" and insist on using antibacterial products. What does the overuse of these products do us (and to the bacterial populations) in the long run? This could link up to MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. I think this would be very appropriate for the MS level (not necessarily for 3-5—keep the focus on improved handwashing to decrease disease transmission. I made another suggestion for Grades 3-5).

Project WET: High Water History

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	**Earth's Systems/ Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 321
Brief Lesson Description: By analyzing a flood map, calculating economic loss that results from flooding in a specific area and investigating the history of flood disasters, students learn how people are affected by floods and other weather events.		
Performance Expectation: MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.		
Performance Expectation: . Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings. **(MS-ESS3-2)** • *Students conduct an investigation to understand flood probability terms. (Part I, steps 1-6).* • *Students read and interpret the USGS fact sheet 'What is a 100-Year Flood?'* • *Students investigate and compare aftermaths of historical flood disasters of note. (Extensions)* • *Students study a hypothetical hazard map.* • *Students calculate individual and community losses for a damage report (Part II, step 6).* • *Students assess the impact of a simulated water-related natural disaster (Part II, steps 5-7).* • *Students use an online program to research the flood risk for their home, school and/or a local community in a floodplain.* • *Students research home prices to assess the mean value of local homes in a floodplain community.* • *Students investigate an online flood risk calculator and compare results to their damage assessments for a given area.* • *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)*	**ESS2.A: Earth's Materials and Systems** The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **(MS-ESS2-2)** • *Students investigate and compare aftermaths of historical flood disasters of note. (Extensions)* • *Students assess the impact of a simulated water-related natural disaster (Part II, steps 5-7).* • *Students use an online program to research the flood risk for their home, school and/or a local community in a floodplain.* • *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)* **ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. **(MS-ESS2-2)** • *Students develop a list of characteristics that define some natural events as disasters (Warm-Up).* • *Students investigate and compare aftermaths of historical flood disasters of note. (Extensions)* • *Students assess the impact of a simulated water-related natural disaster (Part II, steps 5-7).* • *Students use an online program to research the flood risk for their home, school and/or a local community in a floodplain.*	**Patterns** Graphs, charts, and images can be used to identify patterns in data. **(MS-ESS3-2)** • *Students conduct an investigation to understand flood probability terms. (Part I, steps 1-6).* • *Students read and interpret the USGS fact sheet 'What is a 100-Year Flood?'* • *Students investigate and compare aftermaths of historical flood disasters of note. (Extensions)* • *Students study a hypothetical hazard map.* • *Students calculate individual and community losses for a damage report (Part II, step 6).* • *Students assess the impact of a simulated water-related natural disaster (Part II, steps 5-7).* • *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)* **Scale Proportion and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **(MS-ESS2-2)** • *Students develop a list of characteristics that define some natural events as disasters (Warm-Up).* • *Students create and revise a definition for '100-year flood' (Part I)* • *Students conduct an investigation to understand flood probability terms. (Part I, steps 1-6).* • *Students read and interpret the USGS fact sheet 'What is a 100-Year Flood?'* • *Students investigate and compare aftermaths of historical flood disasters of note. (Extensions)* • *Students study a hypothetical hazard map.* • *Students calculate individual and community*

Constructing Explanations and Designing Solutions
Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.
(MS-ESS2-2)

- *Students develop a list of characteristics that define some natural events as disasters (Warm-Up).*
- *Students create and revise a definition for '100-year flood' (Part I)*
- *Students conduct an investigation to understand flood probability terms. (Part I, steps 1-6).*
- *Students read and interpret the USGS fact sheet 'What is a 100-Year Flood?'*
- *Students investigate and compare aftermaths of historical flood disasters of note. (Extensions)*
- *Students assess the impact of a simulated water-related natural disaster (Part II, steps 5-7).*
- *Students use an online program to research the flood risk for their home, school and/or a local community in a floodplain.*
- *Students research home prices to assess the mean value of local homes in a floodplain community.*
- *Students investigate an online flood risk calculator and compare results to their damage assessments for a given area.*
- *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)*

- *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)*

ESS3.B: Natural Hazards
Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. **(MS-ESS3-2)**

- *Students conduct an investigation to understand flood probability terms. (Part I, steps 1-6).*
- *Students read and interpret the USGS fact sheet 'What is a 100-Year Flood?'*
- *Students study a hypothetical hazard map.*
- *Students calculate individual and community losses for a damage report (Part II, step 6).*
- *Students assess the impact of a simulated water-related natural disaster (Part II, steps 5-7).*
- *Students use an online program to research the flood risk for their home, school and/or a local community in a floodplain.*
- *Students research home prices to assess the mean value of local homes in a floodplain community.*
- *Students investigate an online flood risk calculator and compare results to their damage assessments for a given area.*
- *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)*

losses for a damage report (Part II, step 6).

- *Students assess the impact of a simulated water-related natural disaster (Part II, steps 5-7).*
- *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)*

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-2)**

- *Students study a hypothetical hazard map.*
- *Students calculate individual and community losses for a damage report (Part II, step 6).*
- *Students assess the impact of a simulated water- related natural disaster (Part II, steps 5-7).*
- *Students use an online program to research the flood risk for their home, school and/or a local community in a floodplain.*
- *Students research home prices for to assess the mean value of local homes in a floodplain community.*
- *Students investigate an online flood risk calculator and compare results to their damage assessments for a given area.*
- *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)*

NGSS Common Core Connections:
ELA/Literacy –
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2),(MS-ESS3-2)
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2)
WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)
SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-2)
Mathematics –
MP.2 Reason abstractly and quantitatively. (MS-ESS2-2), (MS-ESS3-2)
Connections to other Common Core Standards at this Grade Level: RH.6-8.7; RST.6-8.2; RST.6-8.3; RST.6-8.4; RST.6-8.9; SL.6-8.1; SL.6-8.4; WHST.6-8.7

<table>
<tr><th colspan="2">Additional SEP Connections: Grades 6-8</th></tr>
<tr><td>Asking questions (for science) and defining problems (for engineering)</td><td>Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
Ask questions
that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
to identify and/or clarify evidence and/or the premise(s) of an argument.
to determine relationships between independent and dependent variables and relationships in models.
to clarify and/or refine a model, an explanation, or an engineering problem.
that require sufficient and appropriate empirical evidence to answer.
that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
that challenge the premise(s) of an argument or the interpretation of a data set.</td></tr>
<tr><td>Developing and using models</td><td>Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed.
Develop and/or use a model to predict and/or describe phenomena.
Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales</td></tr>
<tr><td>Planning and carrying out investigations</td><td>Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.
Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Evaluate the accuracy of various methods for collecting data.
Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Collect data about the performance of a proposed object, tool, process or system under a range of conditions.</td></tr>
<tr><td>Analyzing and interpreting data</td><td>Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
Distinguish between causal and correlational relationships in data.
Analyze and interpret data to provide evidence for phenomena.
Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible.
Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).
Analyze and interpret data to determine similarities and differences in findings.</td></tr>
<tr><td>Using mathematics and computational thinking</td><td>Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.
Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends.
Use mathematical representations to describe and/or support scientific conclusions and design solutions.
Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.</td></tr>
</table>

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB
Incredible Journey correlates well to the MS grade NGSS Performance Expectations MS-ESS2-2 and MS-ESS3-2, *IF* a number of the existing components are enhanced and the activity is re-aligned to integrate current extensions. These changes will add the required rigor correlate to most of the CCSS connected to these PEs, which the activity does not correlate to *as written*. Below is a suggested re-alignment outline with the suggested modifications to enhance or add in gray.	

Warm-up: Characteristics of a Disaster

- *Students develop a list of characteristics that define some natural events as disasters (Warm Up).*

Part I: Defining Flood Probability

- *Students create and revise a definition for '100-year flood' (Part I)*
- *Students conduct an investigation to understand flood probability terms. (Part I, steps 1-6).*
- *Students read and interpret the USGS fact sheet 'What is a 100-Year Flood?'*

Part II:

- *Students investigate and compare aftermaths of historical flood disasters of note. (Extensions)*
- *Students study a hypothetical hazard map.*
- *Students calculate individual and community losses for a damage report (Part II, step 6).*
- *Students discuss the difference between economic and emotional value of possessions (Warm Up; Part II, step 8; Wrap Up).*
- *Students assess the impact of a simulated water- related natural disaster (Part II, steps 5-7).*

Part III:

- *Students use an online program to research the flood risk for their home, school and/or a local community in a floodplain.*
- *Students research home prices to assess the mean value of local homes in a floodplain community.*
- *Students investigate an online flood risk calculator and compare results to their damage assessments for a given area.*

Part IV: ActionEducation

- *Students develop a flood hazard report for an area, including a flood hazard map and flood damage estimates for a range of potential flood events. (Extensions)*

Determining Risk: https://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/understanding_flood_maps.jsp

Flood Topic Overview: https://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/ffr_overview.jsp

Map My Risk: http://www.floodtools.com/Map.aspx

The Cost of Flooding: https://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/the_cost_of_flooding.jsp

Home Price Assessment: http://www.zillow.com

Project WET: Hitting the Mark

* Activities are correlated <u>as written.</u> However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 3-5	**Engineering Design**	**Project WET Guide, Page #:** Guide 2.0, page 327
Brief Lesson Description: Students investigate the concepts of accuracy and precision in data collection and learn the importance of writing detailed procedures.		
Performance Expectation: 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.		
Performance Expectation: 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. **(3-5-ETS1-2)** • *Brainstorm ways students could improve their accuracy and precision in this activity (e.g., eye-hand coordination, distance from target, lighting, practice). Conduct the activity again using the methods for improvement that the students came up with. Was there a change in the accuracy and precision of their results using the improvements? (Extension)* **Planning and Carrying Out Investigations** Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. **(3-5-ETS1-3)** • *Have students experiment with different ways of dropping the balls onto the target to maximize their precision and accuracy. (Activity Step 4)* • *Instruct students to record detailed procedures for this method. Using their written procedures, have the students conduct three separate trials and record their results directly on the target using three different colored pens to signify each trial. (Activity, Step 5)*	**ETS1.B: Developing Possible Solutions** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. **(3-5-ETS1-2)** • *Have the students experiment with different ways of dropping the balls onto the target to maximize their precision and accuracy (Activity, Step 4)* • *When the individual groups devise a method that they feel is accurate and precise, instruct them to record detailed procedures for this method. (Activity Step 5)* • *Using their written procedures, have the students conduct three separate trials and record their results directly on the target using three different colored pens to signify each trial. Activity Step 5)* At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. **(3-5-ETS1-2)** • *Have each group present their procedures and results. Were their results both accurate and precise? Discuss with the students what could explain any variability of the results between the groups. (Activity Step 6)* **ETS1.B: Developing Possible Solutions** Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **(3-5-ETS1-3)** • *Have the students experiment with different ways of dropping the balls onto the target to maximize their precision and accuracy (Activity, Step 4)*	**Influence of Science, Engineering, and Technology on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. **(3-5-ETS1-2)** • *How could "technology" improve their results? Explain that technology is often considered electronic or computer-oriented. However, the spoon was probably considered high-tech when it was invented. Have students brainstorm other tools in the classroom that qualify as "technology." (Extension)* • *Using the same groups and materials from the original activity, distribute instruments of increasingly sophisticated "technology" to the groups. For example, distribute the following (or use other equipment available in your classroom): • a plastic spoon to the first group • a plastic spoon and cup to the second group • a plastic spoon and a plumb line(3' string) to the third group (Extension)*

	ETS1.C: Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. **(3-5-ETS1-3)** • *Have students review data sets by using three different methods used by the groups to drop clay balls onto their targets and determine differences in accuracy and precision for the three different methods. Have students report findings to the class. Ask students, "Why would one method be more accurate than another? Why would one method be more precise than another?" (Activity Part III, Steps 1-3)*	

NGSS Common Core Connections:

ELA/Literacy -

Mathematics -

MP.2 Reason abstractly and quantitatively. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)

MP.5 Use appropriate tools strategically. *(*3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)

Connections to other Common Core Standards at this Grade Level:

ELA: 6-12.SEP.3; 6-12.SEP.4; 6-12.SEP.8; 6-12.CC.1 NONE RST.6-12.3; RST.6-12.4; SL.6-12.1; WHST.6-12.4

Math: 6.SP.5

Additional SEP Connections:	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop and/or use models to describe and/or predict phenomena.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. **(3-5-ETS1-3)** • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success

Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Use data to evaluate and refine design solutions.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. **(3-5-ETS1-2)**
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct and/or support an argument with evidence, data, and/or a model. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	Correlator Initials: MJW

Project WET: Hitting the Mark

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extensions section of the activity.*

Grade: Middle School	**Engineering Design**	**Project WET Guide, Page #:** Guide 2.0, page 327
Brief Lesson Description: Students investigate the concepts of accuracy and precision in data collection and learn the importance of writing detailed procedures.		
Performance Expectation: **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Performance Expectation: **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Engaging in Argument from Evidence Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-ETS1-2)** • *Ask groups to devise a method that they feel is accurate and precise, and record detailed procedures for this method. Using their written procedures, students conduct three separate trials and record their results. (Part I, Step 5)* • *Each group present their procedures and results. Were their results both accurate and precise? Discuss with the students what could explain any variability of the results between the groups. (Part 1, Step 6)* • *Have students review data sets by using three different methods used by the groups to drop clay balls onto their targets. Have students determine differences in accuracy and precision for the three different methods and report findings to the class. Ask students, "Why would one method be more accurate than another? Why would one method be more precise than another?" (Part III, Steps 1-3)* **Analyzing and Interpreting Data** Analyze and interpret data to determine similarities and differences in findings. **(MS-ETS1-3)** • *Have students review data sets by using three different methods used by the groups to drop clay balls onto their targets. Have students determine differences in accuracy and precision for the three different methods and report findings to the class. Ask students, "Why would one method be more accurate than another? Why would one method be more precise than another?" (Part III, Steps 1-3)*	**ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2), (MS-ETS1-3)** • *Have each group present their procedures and results. Were their results both accurate and precise? Discuss with the students what could explain any variability of the results between the groups. (Part I, Step 6)* • *Have students review data sets by using three different methods used by the groups to drop clay balls onto their targets. Have students determine differences in accuracy and precision for the three different methods. (Part III, Step 1)* Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. **(MS-ETS1-3)** • *Have students review data sets by using three different methods used by the groups to drop clay balls onto their targets. Have students determine differences in accuracy and precision for the three different methods. Ask students to consider the parts of each method that worked the best. Could these be combined to create a better solution? (Part III, Step 1)* • *Brainstorm ways students could improve their accuracy and precision in this activity (e.g., eye-hand coordination, distance from target, lighting, practice). Encourage students to combine parts of different methods that worked the best during the activity. Conduct the activity again using the methods for improvement that the students came up with. Was there a change in the accuracy and precision of*	**No CCC provided in NGSS for these PEs**

	their results using the improvements? **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. **(MS-ETS1-3)** • *Have students review data sets by using three different methods used by the groups to drop clay balls onto their targets. Have students determine differences in accuracy and precision for the three different methods. Ask students to consider the parts of each method that worked the best. Could these be combined to create a better solution? (Part III, Step 1)*	

NGSS Common Core Connections:

ELA/Literacy -

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)

Mathematics -

MP.2 Reason abstractly and quantitatively. (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4)

Connections to other Common Core Standards at this Grade Level:

ELA: RST.6-12.3; RST.6-12.4; SL.6-12.1; WHST.6-12.4 ***Math***: 6.SP.5

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Evaluate the accuracy of various methods for collecting data. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.

Correlation Comments	**Correlator Initials:** MJW
No comments	

Project WET: Hot Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: HS		Project WET Guide, Page #: Guide 1.0, p. 388
Brief Lesson Description: Using debate strategies, students learn how to present a valid argument regarding a water-related issue.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**

NGSS Common Core Connections:
ELA/Literacy – NA
Mathematics – NA
Connections for Hot Water to other Common Core Standards at this Grade Level: Evidence is a huge piece for this activity and that is also important for ELA Common Core, along with providing resources to back up an argument, so I anticipate there would be matches to this activity.

Additional SEP Connections: Grades 9-12	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions • Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or edit reports, verifying the data when possible. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Correlation Comments	**Correlator Initials:** ELC

Hot Water is a great activity to help students understand the process of a debate—in this case, the issues selected will all be water-related. Depending upon which topics are selected, there might be some links to several NGSS PEs. But, since the PROCESS of debate is the focus here, I could not officially assign any specific NGSS PEs here.

The debate topics selected could all help provide students the opportunity to focus on providing *evidence,* which is huge for both NGSS and for the ELA Common Core standards too. As a result, some SEPs and CCCs are mentioned here as possible connections to this activity.

A logical area that might apply would be the Earth and Human Activity section (HS-ESS3)

Project WET: A House of Seasons

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: Kindergarten	**Weather and Climate**	**Project WET Guide, Page #:** Guide 1.0, Portal
Brief Lesson Description: By constructing a "House of Seasons" collage, students observe the role of water in each of the seasons.		
Performance Expectation: K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.		
Performance Expectation: K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Planning and Carrying Out Investigations Make observations (firsthand or from media) to collect data that can be used to make comparisons. **(K-PS3-1)** • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water* • *Students use math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* **Analyzing and Interpreting Data** Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. **(K-ESS2-1)** • *Students identify or draw pictures of the seasons (Step 1).* • *Students design a House of Seasons collage (steps 5 and 6).* • *Students use math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year .* • *Students compare the appearances and states of water in each season (step 4).* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* .... ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** Scientists use different ways to study the world. **(K-PS3-1)** • *Students describe the different seasons and identify how many of their descriptions*	**PS3.B: Conservation of Energy and Energy Transfer** Sunlight warms Earth's surface. **(K-PS3-1)** • *Students compare the presence and appearance of water in each season (step 4).* • *Students develop questions about the differences in the presence and appearance of water in each season.* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* **ESS2.D: Weather and Climate** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. **(K-ESS2-1)** • *Students describe the different seasons and identify how many of their descriptions involve water.* • *Students identify or draw pictures based on their perceptions of the seasons (step 1).* • *Students compare the presence and appearance of water in each season (step 4).* • *Students develop questions about the differences in the presence and appearance of water in each season.* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water* • *Students use math to analyze their recorded observations of the seasons – i.e., number of*	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. **(K-ESS2-1)** • *Students describe the different seasons and identify how many of their descriptions involve water.* • *Students identify or draw pictures based on their perceptions of the seasons (step 1).* • *Students compare the presence and appearance of water in each season (step 4).* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water* • *Students use math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* **Cause and Effect** Events have causes that generate observable patterns. **(K-PS3-1)** • *Students compare the presence and appearance of water in each season (step 4).* • *Students develop questions about the differences in the presence and appearance of water in each season.* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow*

involve water. • *Students identify or draw pictures based on their perceptions of the seasons (step 1).* • *Students compare the presence and appearance of water in each season (step 4).* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water (Extension)* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students keep a daily weather journal and record observations throughout the year.* **Science Knowledge is Based on Empirical Evidence** Scientists look for patterns and order when making observations about the world. **(K-ESS2-1)** • *Students record observations of each season with a focus on water during the school year (Extension)* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year*	*sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students compare the appearances and states of water in each season (step 4).* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students keep a daily weather journal and record observations throughout the year.*	*vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students keep a daily weather journal and record observations throughout the year.*

NGSS Common Core Connections:

ELA/Literacy –

W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1), (K-ESS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (K-ESS2-1)

MP.4 Model with mathematics. (K-ESS2-1)

K.CC.1-3 Know number names and the count sequence. (K-ESS3-1)

K.CC.4-5 Count to tell the number of objects. (K-ESS3-1)

K.CC.6-7 Compare numbers. (K-ESS3-1)

K.MD.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-ESS2-1)

K.MD.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS3-1)

K.MD.3 Classify objects into given categories; count the number of objects in each category and sort the categories by count. (K-ESS2-1)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Energy and Matter	Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.
Stability and Change	Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** DBB

A House of Seasons has a weak correlation to the Kindergarten NGSS Performance Expectation K-ESS2-1 and no correlation to K-PS3-1 or the CCSS connected with either PE *as written.* A House of Seasons *could* align well with both PEs and the connecting CCSS with the simple addition of a sample weather data chart template, directions to use simple math to analyze data and modifications in grey to the activity. Also highly recommend asking ECE team within P & P WET team review activity for further suggestions to better align activity to the NGSS and CCSS correlations. An outline of suggested modifications and alignment is below:

Warm-up:
- *Students describe the different seasons and identify how many of their descriptions involve water.*

Part I: Perceptions of Water & the Seasons
- *Students identify or draw pictures based on their perceptions of the seasons (step 1).*
- *Students compare the presence and appearance of water in each season (step 4).*
- *Students develop questions about the differences in the presence and appearance of water in each season.*

Part ll: Observing Water & the Seasons
- *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water.*
- *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.*

Part III: Using Science to Revise Perceptions

- *Students compare their House of Seasons collage with their recorded observations of each season during the school year*
- *Students revise their House of Seasons collage based on their recorded observations of each season during the school year*

Part IV: ActionEducation

- *Students keep a daily weather journal and record observations throughout the year.*

Project WET: A House of Seasons

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 1	**Space Systems:** Patterns and Cycles	**Project WET Guide, Page #:** Guide 1.0, Portal
Brief Lesson Description: By constructing a "House of Seasons" collage, students observe the role of water in each of the seasons.		
Performance Expectation: 1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Planning and Carrying Out Investigations Make observations (firsthand or from media) to collect data that can be used to make comparisons. **(1-ESS1-2)** • *Students develop questions about the differences in the presence and appearance of water in each season.* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students keep a daily weather journal and record observations throughout the year.*	**ESS1.B: Earth and the Solar System** Seasonal patterns of sunrise and sunset can be observed, described, and predicted. **(1-ESS1-2)** • *Students describe the different seasons and identify how many of their descriptions involve water.* • *Students identify or draw pictures based on their perceptions of the seasons (step 1).* • *Students compare the presence and appearance of water in each season (step 4).* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students keep a daily weather journal and record observations throughout the year.*	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. **(1-ESS1-2)** • *Students describe the different seasons and identify how many of their descriptions involve water.* • *Students identify or draw pictures based on their perceptions of the seasons (step 1).* • *Students compare the presence and appearance of water in each season (step 4).* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students revise their House of Seasons collage based on their recorded observations of each season during the school year* • *Students keep a daily weather journal and record observations throughout the year.*

NGSS Common Core Connections:
ELA/Literacy –
W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). **(1-ESS1-2)**
W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. **(1-ESS1-2)**
Mathematics –
MP.2 Reason abstractly and quantitatively. **(1-ESS1-2)**
MP.4 Model with mathematics. **(1-ESS1-2)**
MP.5 Use appropriate tools strategically. **(1-ESS1-2)**
1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown

	number to represent the problem. **(1-ESS1-2)**
1.MD.4	Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. (1-ESS1-2)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	SStudents understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Energy and Matter	Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.
Stability and Change	Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments | **Correlator Initials:** DBB

A House of Seasons has almost no correlation to the 1st NGSS Performance Expectation 1-ESS1-2 *as written, but could* align well with the PE and connecting CCSS with the simple addition of a sample weather data chart template, directions to use simple math to analyze data and modifications in grey are made to the activity. Also highly recommend asking ECE team within P & P WET team review activity for further suggestions to better align activity to the NGSS and CCSS correlations. An outline of suggested modifications is below:

Warm-up:
- *Students describe the different seasons and identify how many of their descriptions involve water.*

Part I: Perceptions of Water & the Seasons
- *Students identify or draw pictures based on their perceptions of the seasons (step 1).*
- *Students compare the presence and appearance of water in each season (step 4).*
- *Students develop questions about the differences in the presence and appearance of water in each season.*

Part lI: Observing Water & the Seasons
- *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water.*

- *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.*

Part III: Using Science to Revise Perceptions

- *Students compare their House of Seasons collage with their recorded observations of each season during the school year*
- *Students revise their House of Seasons collage based on their recorded observations of each season during the school year*

Part IV: ActionEducation

- *Students keep a daily weather journal and record observations throughout the year.*

Project WET: A House of Seasons

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 3	**Weather and Climate**	**Project WET Guide, Page #:** Guide 1.0, Portal
Brief Lesson Description: By constructing a "House of Seasons" collage, students observe the role of water in each of the seasons.		
Performance Expectation: 3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.		
Performance Expectation: 3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. **(3-ESS2-1)** • *Students compare the presence and appearance of water in each season (step 4).* • *Students develop questions about the differences in the presence and appearance of water in each season.* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year.* • *Students compare the appearances and states of water in each season (step 4).* • *Students compare their weather observations to mean weather and climate data trends for their area.* • *Students keep a daily weather journal and record observations throughout the year.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and other reliable media to explain phenomena. **(3-ESS2-2)** • *Students compare the presence and appearance of water in each season (step 4).* • *Students obtain data on local weather data over time.* • *Students compare their weather observations to mean weather and climate data trends for their area.* • *Students keep a daily weather journal and record observations throughout the year.*	**ESS2.D: Weather and Climate** Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. **(3-ESS2-1)** • *Students describe the different seasons and identify how many of their descriptions involve water.* • *Students identify or draw pictures of and describe the seasons (Step 1).* • *Students compare the presence and appearance of water in each season (step 4).* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year* • *Students compare their weather observations to mean weather and climate data trends for their area.* • *Students keep a daily weather journal and record observations throughout the year.* Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. **(3-ESS2-2)** • *Students describe the different seasons and identify how many of their descriptions involve water.* • *Students identify or draw pictures of and describe the seasons (Step 1).* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water.* • *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.*	**Patterns** Patterns of change can be used to make predictions. **(3-ESS2-1), (3-ESS2-2)** • *Students describe the different seasons and identify how many of their descriptions involve water.* • *Students identify or draw pictures of and describe the seasons (Step 1).* • *Students compare the presence and appearance of water in each season (step 4).* • *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water.* • *Students compare their House of Seasons collage with their recorded observations of each season during the school year.* • *Students compare their weather observations to mean weather and climate data trends for their area.* • *Students keep a daily weather journal and record observations throughout the year.*

	• *Students obtain data on local weather data over time.* • *Students keep a daily weather journal and record observations throughout the year.*	

NGSS Common Core Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-ESS2-2)

RI.3.9 Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2)

W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. **(**3-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (3-ESS2-1),(3-ESS2-2)

MP.4 Model with mathematics. (3-ESS2-1),(3-ESS2-2)

MP.5 Use appropriate tools strategically. (3-ESS2-1)

3.MD.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-ESS2-1)

3.MD.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. **(**3-ESS2-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Energy and Matter	Students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

A House of Seasons has a very weak to no correlation to the 3rd grade NGSS Performance Expectations (3-ESS2-1),(3-ESS2-2) *as written.* However, the simple addition of a sample weather data chart template, directions to use simple math and graphing to analyze data and inclusion of a couple of reliable websites in the activity footnotes where students or teachers can locate local weather data by month, year and/or season would fully align this activity with both PEs and the connecting CCSS if the modifications in grey are made to the activity. Also highly recommend asking ECE team within P & P WET team review activity for further suggestions to better align activity to the NGSS and CCSS correlations.

Warm-up:

- *Students describe the different seasons and identify how many of their descriptions involve water.*

Part I: Perceptions of Water & the Seasons

- *Students identify or draw pictures based on their perceptions of the seasons (step 1).*
- *Students compare the presence and appearance of water in each season (step 4).*
- *Students develop questions about the differences in the presence and appearance of water in each season.*

Part ll: Observing Water & the Seasons

- *Students record observations of each season during the school year with a focus on sunlight, temperature, weather conditions and state of water.*
- *Students use grade appropriate math to analyze their recorded observations of the seasons – i.e., number of sunny vs. cloudy days, days below vs. above freezing, snow vs. rainy vs. foggy days, etc.*

Part Ill: Using Science to Revise Perceptions

- *Students compare their House of Seasons collage with their recorded observations of each season during the school year*
- *Students revise their House of Seasons collage based on their recorded observations of each season during the school year*

Part IV: ActionEducation

- *Students keep a daily weather journal and record observations throughout the year.*

Project WET: Humpty Dumpty

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 335
Brief Lesson Description: Students relate the challenges of environmental restoration projects to piecing together puzzles, broken items or clay pots		
Performance Expectation: MS-ESS3-3.: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • *Recognizing the need for humans to continue using natural resources, ask students to identify strategies for maintaining the integrity of ecosystems (inventory plant and animal species, monitor water quality, employ best management practices, etc.). (Wrap Up)* • *Have students identify a potential water-related restoration project. Students should consider the following: establishing a restoration goal, formulating a restoration plan, predicting difficulties, analyzing costs, determining a time frame, projecting results (e.g., illustrating the potential appearance of a restored site) and maintaining restored sites. If the project proves feasible and students undertake restoration of a site, have them maintain a project diary or water log and circulate copies to other teachers and students. (ActionEducation)* • *Design a process or system to mitigate human impacts that lead to the need for restoration at a certain cite. Present orally or in written form.*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Drop the egg on the floor or a table from enough height to crack it. Show students the cracked egg, passing it around if desired. Discuss if it could be put back together. (Warm Up)* • *Show students pictures of altered sites. Discuss ways natural events (floods, hurricanes, tornadoes) and human activities (contaminating ground water with toxins, draining wetlands, building canals) affect natural habitats. (Warm Up)* • *Instruct students to scatter the pieces on their desk top. Explain that this represents a natural area that has been altered. (Activity, Option 1, Step 3)* • *Some objects (such as a frying pan with handle) are relatively easy to assemble once dismantled and require few resources. This is analogous to restoring a spot on the school grounds where a delivery truck has left a tire track. A few scoops of soil, a little packing, some grass seeds and in a few weeks the spot is gone. On the other hand, some restoration projects are of monumental scope, requiring huge amounts of money, energy and time. Use a dismantled clock to demonstrate this type of project. (Activity, Option 2, Step 2)* • *Explain that natural events (such as floods, fires, hurricanes and tornadoes) and human activities (such as mining, agriculture, building construction, road construction and industry) affect ecosystems. (Activity, Option 3, Step 3)* • *Ask the students to trade bags with another group and then ask the students*	**Cause and Effect** • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *More emphasis needs to be placed on real life case studies, examining what type of human behaviors/natural events lead to the need for restoration and what we as humans might be able to do preventatively. Ask students to research or read preselected case studies to learn more about restoration projects come about and ways to prevent needing them.*

	to drop the bag on the ground to break the pot (alter the ecosystem). (Activity, Option 3, Step 5) • Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-3), (MS-ESS3-4)** • *Share with students (or have them research) before and after photos of successful restoration projects.* • *Ask students to think about alternatives to restoration. How can we protect our natural areas so that difficult restoration projects are not necessary?* • *Have students research other water-related restoration projects that are underway locally, regionally or nationally. Contact the Environmental Protection Agency, the U.S. Army Corps of Engineers and the Bureau of Reclamation for information about environmental restoration projects. (Extension)* • *To see an example of a complex restoration, have students visit the official website of the Comprehensive Everglades Restoration Plan (www.evergladesplan.org). Students can prepare a brief news report (written or presented on video) about one aspect of the restoration. The combined work of the class can be put together as a newspaper, magazine or video news journal. (Extension)*	

NGSS Common Core Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-4),(MS-ESS3-5)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2)

WHST.6-8.1 Write arguments focused on discipline content. (MS-ESS3-4)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS3-3)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1),(MS-ESS3-4)

Mathematics -

MP.2 Reason abstractly and quantitatively. (MS-ESS3-2),(MS-ESS3-5)

Connections to other Common Core Standards at this Grade Level: *ELA*: RST.6-8.3; SL. 3-8.1; SL.3-6.2; SL.3.3;

Additional SEP Connections:

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level	
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** MJW
Possible alignments *K-ESS3-3* *5-ESS3-1* *MS-ESS3-3** *HS-LS4-6* *HS-ESS3-4* *Since this activity is focused on potential difficulty of restoration, and not necessarily restoration practices, it does not really align with the above listed Performance Expectations. The closest one is MS-ESS3-3 and am providing options to increase the focus of Humpty Dumpty to better address the components of the Performance Expectation.*	

Project WET: Idea Pools

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: **Pre-K, Upper Elementary, MS and HS**	**Topic: Gathering information about water**	**Project WET Guide, Page #:** Guide 2.0, p. xxiii
Brief Lesson Description: This teaching strategy involves using a network of ideas to pool (categorize) students' interests, thoughts, feelings, and experiences related to water and water concepts.		
Performance Expectation:		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
NA	NA	NA

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s).
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Identify scientific (testable) and non-scientific (non-testable) questions. • Use prior knowledge to describe problems that can be solved.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.
Obtaining, evaluating and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional SEP Connections: Grades 6-8	
Asking question (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional SEP Connections: Grades 9-12	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.

Correlation Comments	**Correlator Initials:** ELC
This activity is about a teaching process, and not science specifically, so no links to the NGSS here. Several Additional SEPs and CCCs are included, though. Reading and writing do apply, so links to the Common Core standards are included.	

Project WET: The Incredible Journey

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 2	**Earth's Systems: Processes that Shape the Earth**	**Project WET Guide, Page #:** Guide 2.0, p. 155

Brief Lesson Description: With a roll of a cube, students simulate the movement of water within the water cycle. By role-playing a water molecule, students learn to conceptualize the water cycle in a way that more closely approximates how water actually travels.

Performance Expectation: 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.

Performance Expectation: 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Performance Expectation: 2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Developing and Using Models Develop a model to represent patterns in the natural world. **(2-ESS2-2)** • *Students create a bracelet and a map to keep track of their movements.* • *Students create a simple diagram or model showing the cycling of water between land and bodies of water in their area.* **Engaging in Argument from Evidence** Construct an argument with evidence to support a claim. **(2-PS1-4)** • *Students identify the states of water as it moves through the water cycle. (step 8; Wrap Up).* • *Students compare the movement of water during different seasons. (Extension)* • *Students write a story describing the journey of their molecule through the water cycle. (Wrap Up).* **Obtaining, Evaluating, and Communicating Information** Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. **(2-ESS2-3)** • *Students write a story describing the journey of their molecule through the water cycle. (Wrap Up).* • *Students graph and calculate percentages for how often their water molecule visited a water location found on Earth. (Extension in CA)* • *Students identify the states water can take as it moves through the hydrological cycle (step 8; Wrap Up).* • *Students compare the movement of water during different seasons. (Extension)*	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps show where things are located. One can map the shapes and kinds of land and water in any area. **(2-ESS2-2)** • *Students create a bracelet and a map to keep track of their movements through the water cycle in the classroom.* • *Students create a simple diagram or model showing the cycling of water between land and bodies of water in their area.* **ESS2.C: The Roles of Water in Earth's Surface Processes** Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. **(2-ESS2-3)** • *Students categorize the places water can reside during its journey through the water cycle.* • *Students identify the states of water as it moves through the water cycle. (step 8; Wrap Up).* • *Students write a story describing the journey of their molecule through the water cycle. (Wrap Up).* • *Students compare the movement of water during different seasons. (Extension)* **PS1.B: Chemical Reactions** Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. **(2-PS1-4)** • *Students identify the states of water as it moves through the water cycle. (step 8; Wrap Up).* • *Students write a story describing the journey of their molecule through the water cycle. (Wrap-Up).*	**Cause and Effect** Events have causes that generate observable patterns. **(2-PS1-4)** • *Students compare the movement of water during different seasons. (Extension)* • *Students create a simple diagram or model showing the cycling of water between land and bodies of water in their area.* **Patterns** Patterns in the natural world can be observed. **(2-ESS2-2), (2-ESS2-3)** • *Students write a story describing the journey of their molecule through the water cycle. (Wrap Up).* • *Students graph and calculate percentages for how often their water molecule visited a water location found on Earth. (Extension in CA)* • *Students identify the states water can take as it moves through the hydrological cycle (step 8; Wrap Up).* • *Students compare the movement of water during different seasons. (Extension)* • *Students create a simple diagram or model showing the cycling of water between land and bodies of water in their area.*

• *Students create a simple diagram or model showing the cycling of water between land and bodies of water in their area.* ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** Scientists search for cause and effect relationships to explain natural events. (2-PS1-4) • *Students identify the states water can take as it moves through the hydrological cycle (step 8; Wrap Up).* • *Students compare the movement of water during different seasons. (Extension)*	• *Students compare the movement of water during different seasons. (Extension)*	

NGSS Common Core Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-PS1-4)

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-PS1-4)

RI.2.8 Describe how reasons support specific points the author makes in a text. (2-PS1-4)

W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., *because, and, also*) to connect opinion and reasons, and provide a concluding statement or section. (2-PS1-4)

W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS1-1),(2-ESS2-3)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1),(2-ESS2-3)

SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (2-ESS2-1),(2-ESS2-1),(2-ESS2-2)

MP.4 Model with mathematics. (2-ESS1-1),(2-ESS2-1),(2-ESS2-2)

2.NBT.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s).
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). • Develop a simple model based on evidence to represent a proposed object or tool.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.

Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use counting and numbers to identify and describe patterns in the natural and designed world(s).
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Distinguish between explanations that account for all gathered evidence and those that do not. • Construct an argument with evidence to support a claim.

Additional Crosscutting Concepts by Grade Level K-2	
Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Energy and Matter	Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.
Stability and Change	Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** DBB
Incredible Journey correlates well to the 2nd grade NGSS Performance Expectations 2-ESS2-3 and I believe to 2-PS1-4. *as written*. However, I would welcome others' interpretations on the correlations made to 2-PS1-4 and general intent of NGSS 'PE packaging' - My thoughts are the more one can get kids to see connections between and apply Earth Science PE elements to Physical Science PE and vice versa, the more in-line with the push for interdisciplinary learning! Incredible Journey *could* align with 2-ESS2-2 if modifications in grey are made to meet the SEP.	

Project WET: The Incredible Journey

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** Blue text represents the Extension section of the activity.*

Grade: 5	**Earth's Systems: Processes that Shape the Earth**	**Project WET Guide, Page #:** Guide 2.0, p. 155

Brief Lesson Description: With a roll of a cube, students simulate the movement of water within the water cycle. By role-playing a water molecule, students learn to conceptualize the water cycle in a way that more closely approximates how water actually travels.

Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Performance Expectation: 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Developing and Using Models Develop a model using an example to describe a scientific principle. (**5-ESS2-1**) • *Students adapt the model used in the game to represent at different locations around the globe. (Extension)* • *Students investigate how water becomes polluted and is cleaned as it moves through the water cycle. (Extension)* • *Students are challenging to adapt the model used in the activity to include processes that pollute and is clean water as it moves through the hydrologic cycle. (Extension)* • *Students create a diagram demonstrating interactions between the hydrosphere and another Earth system – atmosphere, biosphere or geosphere.* **Using Mathematics and Computational Thinking** Describe and graph quantities such as area and volume to address scientific questions. (**5-ESS2-2**) • *Students calculate and investigate ratios between Earth systems to estimate how water moves and in what quantity between Earth systems.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (**5-ESS3-1**) • *Students describe the processes that move water (Warm Up; step 7; Wrap Up).* • *Students write a story describing the*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. (**5-ESS2-1**) • *Students identify the states water can take as it moves through the hydrological cycle (step 8; Wrap Up).* • *Students describe the processes that move water (Warm Up; step 7; Wrap Up).* • *Students create a diagram demonstrating interactions between the hydrosphere and another Earth system – atmosphere, biosphere or geosphere.* **ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (**5-ESS2-2**) • *Students identify the states water can take as it moves through the hydrological cycle (step 8; Wrap Up).* • *Students describe the processes that move water (Warm Up; step 7; Wrap Up).* • *Students calculate and investigate ratios between Earth systems to estimate how water moves and in what quantity between Earth systems.* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight and volume. (**5-ESS2-2**) • *Students calculate and investigate ratios between Earth systems to estimate how water moves and in what quantity between Earth systems.* **Systems and System Models** A system can be described in terms of its components and their interactions. (**5-ESS2-1), (5-ESS3-1**) • *Students identify the states water can take as it moves through the hydrological cycle (step 8; Wrap Up).* • *Students describe the processes that move water (Warm Up; step 7; Wrap Up).* • *Students compare the movement of water during different seasons and at different locations around the globe. (Extension)* • *Students create a diagram demonstrating interactions between the hydrosphere and another Earth system – atmosphere, biosphere or geosphere.*

movement of water (Wrap Up). • *Students create a photo or video documentary of the local watershed that represents each aspect of the water cycle to print in the local or school newspaper or to post online to a blog or video site. (Extension)* • *Students create a diagram demonstrating interactions between the hydrosphere and another Earth system – atmosphere, biosphere or geosphere.*	space. But individuals and communities are doing things to help protect Earth's resources and environments. (**5-ESS3-1**) • *Students investigate how water becomes polluted and is cleaned as it moves through the water cycle. (Extension)* • *Students investigate how human activities can pollute and clean water as it moves through the water cycle. (Extension)* • *Students are challenged to adapt the model used in the activity to include processes that pollute and is clean water as it moves through the hydrologic cycle. (Extension)*	

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5- ESS3-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)

RST.6-12.7

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1),(5-ESS2-2)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2),(5-ESS3-1)

W.5.9.a,b Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

MP.4 Model with mathematics. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)

5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

Connections to other Common Core Standards at this Grade Level: W.3-12.2

Additional SEP Connections: Grade 3-5	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional CCC Connections: Grade 3-5	
Patterns	In grades 3-5, students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Energy and Matter	In grades 3-5, students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.

Correlation Comments	**Correlator Initials:** DBB
Incredible Journey correlates well to 5th grade NGSS Performance Expectations 5-ESS2-1 and 5-ESS2-2 *as written*. Incredible Journey *could* align with 5-ESS3-1 if modifications in grey are made to meet the DCI.	

Project WET: The Incredible Journey

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	**Earth Science:** Earth's Systems	**Project WET Guide, Page #:** Guide 2.0, p. 155
Brief Lesson Description: With a roll of a cube, students simulate the movement of water within the water cycle. By role-playing a water molecule, students learn to conceptualize the water cycle in a way that more closely approximates how water actually travels.		
Performance Expectation: MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to describe unobservable mechanisms. **(MS-ESS2-4)** • *Students role-play a water molecule to conceptualize the water cycle in a way that more closely approximates how water actually travels.* • *Students write a story describing the movement of water (Wrap Up).* • *Students create a photo or video documentary of the local watershed that represents each aspect of the water cycle to print in the local or school newspaper or to post online to a blog or video site.(Extension)* • *Students are challenged to alter the model to reflect the movement of water during different seasons and at different locations around the globe. (Extension)* • *Students create a diagram demonstrating interactions between the hydrosphere and another Earth system – atmosphere, biosphere or geosphere.*	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **(MS-ESS2-4)** Global movements of water and its changes in form are propelled by sunlight and gravity. **(MS-ESS2-4)** • *Students identify and describe the states of water as it moves through the water cycle (step 8; Wrap Up).* • *Students describe the processes that move water on Earth. (Warm Up; step 6-7; Wrap Up).* • *Students write a story describing the movement of water (Wrap Up).* • *Students create a photo or video documentary of the local watershed that represents each aspect of the water cycle to print in the local or school newspaper or to post online to a blog or video site. (Extension)* • *Students create a diagram demonstrating interactions between the hydrosphere and another Earth system – atmosphere, biosphere or geosphere.* • *Students calculate and investigate ratios between Earth systems to estimate how water moves and in what quantity between Earth systems.*	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. **(MS-ESS2-4)** • *Students describe the processes that move water on Earth. (Warm Up; step 6-7; Wrap Up).* • *Students identify and describe the states of water as it moves through the water cycle (step 8; Wrap Up).* • *Students create a photo or video documentary of the local watershed that represents each aspect of the water cycle to print in the local or school newspaper or to post online to a blog or video site. (Extension)* • *Students create a diagram demonstrating interactions between the hydrosphere and another Earth system – atmosphere, biosphere or geosphere.* • *Students are challenged to alter the model to reflect the movement of water during different seasons and at different locations around the globe. (Extension)*
NGSS Common Core Connections: ***None listed for this PE*** **Connections to other Common Core Standards at this Grade Level:** RST.6-12.7; W.3-12.2; WHST.6-12.2		

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation using models or representations. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.

Correlation Comments	**Correlator Initials:** DBB
I think someone wrote MS-ESS2-4 for Incredible Journey – It is the activity being described to help students and teachers build toward achieving this PE in the new draft California Science Framework! It correlates well to MS-ESS2-4 *as written*, but the alignment to this PE and ability to be integrated into addressing additional MS SEPs and CCCs would greatly enhanced if modifications in grey are adopted into the activity text.	

Project WET: Invaders!

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	Earth's Systems/ Ecosystems: Interactions, Energy, and Dynamics	Project WET Guide, Page #: Guide 2.0, p. 263
Brief Lesson Description: Students will learn what aquatic invasive species are and then participate in a full-body movement game that simulates competition for habitat and resources; students will also create graphs and find out about prevention and management of aquatic invasive species.		
Performance Expectation: MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.		
Performance Expectation: MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.		
Performance Expectation: MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.		
Performance Expectation: MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. **(MS-LS2-1)** • *Students graph population numbers to quantify changes in population through time.* • *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.* • *Students calculate the rate of change and compare graphs between all simulated scenarios.* • *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).* • *Students use evidence from research to develop a chart to compare aquatic invasive species information.* • *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.* • *Students identify and compare existing management strategies for controlling aquatic invasive species.*	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. **(MS-LS2-1)** ***Supplemental DCI PS1.B*** In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction**. (MS-LS2-1)** Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. **(MS-LS2-2)** • *Students engage in a simulation of relationships within an undisturbed, native aquatic ecosystem.* • *Students graph population numbers to quantify changes in population through time.* • *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*	**Patterns** Patterns can be used to identify cause and effect relationships. **(MS-LS2-2)** • *Students graph population numbers to quantify changes in population through time.* • *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.* • *Students calculate the rate of change and compare graphs between all simulated scenarios.* • *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).* • *Students use evidence from research to develop a chart to compare aquatic invasive species information.* • *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.* • *Students identify and compare existing management strategies for controlling aquatic invasive species.* **Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-LS2-1)** • *Students graph population numbers to quantify changes in population through time.*

Constructing Explanations and Designing Solutions
Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. **(MS-LS2-2)**

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm-Up).*
- *Students graph population numbers to quantify changes in population through time.*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.**
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students research and develop a class list of aquatic invasive species within their state or region.*
- *Students use the Aquatic Invasive Species Alert Student page criteria to research an aquatic invasive species within their state or region.*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.*
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. **(MS-LS2-4)**
Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. **(MS-LS2-5)**
Supplemental DCI PS1.B, ESS3.A, ESS3.C

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm Up).*
- *Students engage in a simulation of relationships within an undisturbed, native aquatic ecosystem.*
- *Students graph population numbers to quantify changes in population through time.*
- *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.*
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.**
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Stability and Change
Small changes in one part of a system might cause large changes in another part.
(MS-LS2-4),(MS-LS2-5)

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm-Up).*
- *Students graph population numbers to quantify changes in population through time.*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.*
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*

Engaging in Argument from Evidence
Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-LS2-4)**
Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-LS2-5)**

- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Science disciplines share common rules of obtaining and evaluating empirical evidence. **(MS-LS2-4)**

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm Up).*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.**
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

LS4.D: Biodiversity and Humans
Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.
(*secondary to MS-LS2-5*)

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm-Up).*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students research and develop a class list of aquatic invasive species within their state or region.*
- *Students use the Aquatic Invasive Species Alert Student page criteria to research an aquatic invasive species within their state or region.*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Connections to Engineering, Technology, and Applications of Science

Interdependence of Engineering, Technology and Applications of Science on Society and the Natural World
The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-LS2-5)**

- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. **(MS-LS2-5)**

invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension) • *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.* • *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*	**ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. ***(secondary to MS-LS2-5)*** • *Students use the Aquatic Invasive Species Alert Student page criteria to research an aquatic invasive species within their state or region.* • *Students use evidence from research to develop a chart to compare aquatic invasive species information.* • *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.* • *Students identify and compare existing management strategies for controlling aquatic invasive species.* • *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)* • *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.* • *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*	• *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).* • *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.* • *Students identify and compare existing management strategies for controlling aquatic invasive species.* • *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)* • *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.* • *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)
RST.6-8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)
RI.8.8	Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4), (MS-LS2-5)
SL.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS2-2)
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-2)
WHST.6-8.1	Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2)
WHST.6-8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2),(MS-LS2-4)

Mathematics –

MP.4	Model with mathematics. (MS-LS2-5)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5)
6.SP.B.5	Summarize numerical data sets in relation to their context. (MS-LS2-2)

Connections to other Common Core Standards at this Grade Level: RST.6-8.2; RST.6-12.4

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • to identify and/or clarify evidence and/or the premise(s) of an argument. • to determine relationships between independent and dependent variables and relationships in models. • to clarify and/or refine a model, an explanation, or an engineering problem. • that require sufficient and appropriate empirical evidence to answer. • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. • that challenge the premise(s) of an argument or the interpretation of a data set.
Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Analyze and interpret data to determine similarities and differences in findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.

Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB
Invaders! correlates okay to the MS NGSS Performance Expectations MS-LS2-4 *as written*, but not with most of the connecting CCSS. The modifications in gray will strengthen correlation to all dimensions of MS-LS2-4, as well as align the activity for correlation to additional PEs - MS-LS2-1 MS-LS2-2 and MS-LS2-5 – as well as all connecting CCSS. The enhancements will also open the door for MS teachers to use the activity to begin building student proficiency toward PE MS-LS4-4 and MS-ETS1 - Engineering Design. Also highly suggest altering Warm-Up activity to have students read an actual article or species profile to gather evidence to develop a definition and characterization for the term aquatic invasive species. The reading in the guide is too simplistic and leading for use with Secondary students – but the first two links under Resources below are appropriate. A suggested re-alignment outline of modifications is below. **Warm-up: Defining the Issue** • *Students read an article for evidence to describe and define the term aquatic invasive species (Warm Up).*	

Part I: Simulating Relationships in a Native Ecosystem

- *Students engage in a simulation of relationships within an undisturbed, native aquatic ecosystem.*
- *Students graph population numbers to quantify changes in population through time.*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*

Part II:

- *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*
- *Students graph population numbers to quantify changes in native and invasion species population through time in each relationship scenario.**
  ** It is not a valid comparison if a population variable is being changed after one round of a simulation – EACH variation needs to be simulated in order to compare and needs to be compared to a graph of the interactions in the native ecosystem relationships.*
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*

Part III:

- *Students research and develop a class list of aquatic invasive species within their state or region.*
- *Students use the Aquatic Invasive Species Alert Student page criteria to research an aquatic invasive species within their state or region.*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*

Part IV: ActionEducation

- *Student teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Resources:

'Extent and speed of lionfish spread unprecedented; Invasive marine fish may stress reefs':
http://www.sciencedaily.com/releases/2011/03/110314141606.htm
NOAA Lionfish Fact Sheet: http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Lionfish%20Factsheet.pdf
What are Aquatic Invasive Species?
http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Aquatic%20Invasive%20Species%20Overview.pdf
Aquatic Invasive Species – Quick Facts:
http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Aquatic%20Invasive%20Species%20Facts.pdf
Ballast Water – A Pathway for Aquatic Invasive Species:
http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Ballast%20Water%20Factsheet.pdf

Project WET: Invaders!

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: HS	**Ecosystems: Interactions, Energy, and Dynamics**	**Project WET Guide, Page #:** Guide 2.0, p. 263
Brief Lesson Description: Students will learn what aquatic invasive species are and then participate in a full-body movement game that simulates competition for habitat and resources; students will also create graphs and find out about prevention and management of aquatic invasive species.		
Performance Expectation: HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.		
Performance Expectation: HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*		
Performance Expectation: HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. **(MS-LS2-1)** • *Students graph population numbers to quantify changes in population through time.* • *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.* • *Students calculate the rate of change and compare graphs between all simulated scenarios.* • *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).* • *Students use evidence from research to develop a chart to compare aquatic invasive species information.* • *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.* • *Students identify and compare existing management strategies for controlling aquatic invasive species.*	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. **(HS-LS2-6)** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. **(HS-LS2-7)** • *Students read an article for evidence to describe and define the term aquatic invasive species (Warm-Up).* • *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).* • *Students identify and compare existing management strategies for controlling aquatic invasive species.* • *Students teams use their rubric or criteria list to develop a plan to control or eradicate an*	**Patterns** Patterns can be used to identify cause and effect relationships. **(MS-LS2-2)** • *Students graph population numbers to quantify changes in population through time.* • *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.* • *Students calculate the rate of change and compare graphs between all simulated scenarios.* • *Students use evidence from research to develop a chart to compare aquatic invasive species information.* • *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.* • *Students identify and compare existing management strategies for controlling aquatic invasive species.* **Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-LS2-1)** • *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.* • *Students graph population numbers to quantify changes in native and invasive*

Constructing Explanations and Designing Solutions
Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.
(MS-LS2-2)
Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
(HS-ETS1-3)

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm Up).*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Engaging in Argument from Evidence
Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-LS2-4)**
Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-LS2-5)**

- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students research and develop a class list of aquatic invasive species within their state or region.*
- *Students use the Aquatic Invasive Species Alert Student page criteria to research an aquatic invasive species within their state or region.*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

LS4.D: Biodiversity and Humans
Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
(secondary to HS-LS2-7)
Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. **(secondary to HS-LS2-7)**
(Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm-Up).*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

ETS1.B: Developing Possible Solutions
When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. **(HS-ETS1-3), (secondary to HS-LS2-7)**

- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*

Students research and develop a class list of aquatic invasive species within their state or region.

- *Students use the Aquatic Invasive Species Alert Student page criteria to research an aquatic invasive species within their state or region.*

species population through time in each relationship scenario.

- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Stability and Change
Small changes in one part of a system might cause large changes in another part.
(MS-LS2-4),(MS-LS2-5)

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm-Up).*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate*

- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Science disciplines share common rules of obtaining and evaluating empirical evidence. **(MS-LS2-4)**

- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm Up).*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*
- *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.*
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
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- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans*

- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

an aquatic invasive species within their state or region.

- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Connections to Engineering, Technology, and Applications of Science

Interdependence of Engineering, Technology and Applications of Science on Society and the Natural World
The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-LS2-5)**

- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Influence of Science, Engineering, and Technology on Society and the Natural World
New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. **(HS-ETS1-3)**

- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*

to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.		***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. **(MS-LS2-5)** • *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.* • *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).* • *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.* • *Students identify and compare existing management strategies for controlling aquatic invasive species.* • *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)* • *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.* • *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

NGSS Common Core Connections:

ELA/Literacy –

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-6)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-LS2-6), (HS-LS2-7), (HS-ETS1-3)

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-6), (HS-LS2-7)

RST.11-12.8.a–e Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-6), (HS-LS2-7), (HS-ETS1-3)

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-3)

WHST.9–12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS2-7)

Mathematics –

MP.2 Reason abstractly and quantitatively. (HS-LS2-6),(HS-LS2-7),(HS-ETS1-3)

MP.4 Model with mathematics. (HS-ETS1-3)

N-Q.1-3 Reason quantitatively and use units to solve problems. (HS-LS2-7)

S-IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (HS-LS2-6)

S-IC.6 Evaluate reports based on data. (HS-LS2-6)

Connections to other Common Core Standards at this Grade Level: RST.6-12.4

Additional SEP Connections: Grades 9-12	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	• Ask questions
	  • that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
	  • to determine relationships, including quantitative relationships, between independent and dependent variables.
	  • to clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
	• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3 , acre-feet, etc.)
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Scale, Proportion, and Quantity	Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.
Structure and Function	Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
Stability and Change	Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments	**Correlator Initials:** DBB

Invaders! correlates to the content of the HS NGSS Performance Expectations HS-LS2-6 and HS-LS2-7 *as written*, but requires much more rigor to meet the depth of understanding and level of performance to meet the NGSS dimension elements and most of the connecting CCSS. The proposed modifications in gray and suggested realignment below will strengthen correlation to all dimensions and nearly all of the connecting CCSS for HS-LS2-6 and HS-LS2-7 – ***and*** allow correlation to PE HS-ETS1-3.

Also highly suggest altering Warm-Up activity to have students read an actual article or species profile to gather evidence to develop a definition and characterization for the term aquatic invasive species. The reading in the guide is too simplistic and leading for use with Secondary students – but the first two links under Resources below are appropriate. A suggested re-alignment outline of modifications is below.

Warm-up: Defining the Issue
- *Students read an article for evidence to describe and define the term aquatic invasive species (Warm-Up).*

Part I: Simulating Relationships in a Native Ecosystem
- *Students engage in a simulation of relationships within an undisturbed, native aquatic ecosystem.*
- *Students graph population numbers to quantify changes in population through time.*
- *Students summarize the results of the scenario and define key points regarding relationships in a native ecosystem.*

Part II:
- *Students engage in simulation of two relationship variants within an ecosystem disturbed by an aquatic invader.*
- *Students graph population numbers to quantify changes in native and invasive species population through time in each relationship scenario.**
  - ** It is not a valid comparison if a population variable is being changed after one round of a simulation – EACH variation needs to be simulated in order to compare and needs to be compared to a graph of the interactions in the native ecosystem relationships.*
- *Students calculate the rate of change and compare graphs between all simulated scenarios.*
- *Students describe how an aquatic invasive species may disrupt a natural system based on simulation evidence. (Part I and Part II).*

Part III:
- *Students research and develop a class list of aquatic invasive species within their state or region.*
- *Students use the Aquatic Invasive Species Alert Student page criteria to research an aquatic invasive species within their state or region.*
- *Students use evidence from research to develop a chart to compare aquatic invasive species information.*
- *Students develop a rubric or list of criteria to evaluate the effectiveness of management strategies for controlling aquatic invasive species.*
- *Students identify and compare existing management strategies for controlling aquatic invasive species.*
- *Students interview a biologist or other aquatic invasive species expert on aquatic invasive species, management strategies and opportunities for citizen involvement in monitoring & control efforts with the class. (Extension)*

Part IV: ActionEducation
- *Students teams use their rubric or criteria list to develop a plan to control or eradicate an aquatic invasive species within their state or region.*
- *Students compare and evaluate team plans to revise and develop a class plan to control or eradicate aquatic invasive species within their state or region.*

Resources:
'Extent and speed of lionfish spread unprecedented; Invasive marine fish may stress reefs':
http://www.sciencedaily.com/releases/2011/03/110314141606.htm
NOAA Lionfish Fact Sheet: http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Lionfish%20Factsheet.pdf
What are Aquatic Invasive Species?
http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Aquatic%20Invasive%20Species%20Overview.pdf
Aquatic Invasive Species – Quick Facts:
http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Aquatic%20Invasive%20Species%20Facts.pdf
Ballast Water – A Pathway for Aquatic Invasive Species:
http://www.habitat.noaa.gov/pdf/best_management_practices/fact_sheets/Ballast%20Water%20Factsheet.pdf

Project WET: Is There Water on Zork?

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Topic: Matter and Its Interactions	Project WET Guide, Page #: Guide 2.0, p. 27
Brief Lesson Description: Students describe the unique characteristics of water and design investigations to distinguish water from other clear liquids.		
Performance Expectation: MS-PS1-2. Analyze and interpret data on the properties of a substance before and after the substance interact to determine if a chemical reaction has occurred.		
Performance Expectation: MS-PS1-6. Undertake a design project to construct, test and modify a device that either releases or absorbs thermal energy by chemical processes.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. **(MS-PS1-2)** • *Students develop questions and a set of procedures to investigate which clear liquids are actually water. (Parts I and II)* **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. **(MS-PS1-6)** • *Students develop questions and a set of procedures to investigate which clear liquids are actually water. (Parts I and II)*	**PS1.A: Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **(MS-PS1-2), (MS-PS1-3)** • *Students develop questions and a set of procedures to investigate which clear liquids are actually water. (Parts I and II)* **PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. **(MS-PS1-2), (MS-PS1-3), (MS-PS1-5)** • *Students develop questions and a set of procedures to investigate which clear liquids are actually water. (Parts I and II—could include chemical reactions with baking soda and aluminum foil)* Some chemical reactions release energy, others store energy. **(MS-PS1-6)**	**Patterns** Macroscopic patterns are related to the nature of microscopic and atomic-level structure. **(MS-PS1-2)** **Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system. **(MS-PS1-6)**

	ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. **(*secondary to MS-PS1-6)*** • *Students draw conclusions, based on their investigations and evaluate the value of their conclusions and investigative process. (Part II and Wrap Up)* **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. **(secondary to MS-PS1-6)** The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. **(secondary to MS-PS1-6)** • *Students draw conclusions, based on their investigations and evaluate the value of their conclusions and investigative process. (Part II and Wrap Up)*	

NGSS Common Core Connections:
ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (*MS-PS1-2*),(MS-PS1-3)

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). *(MS-PS1-1),(*MS-PS1-2),(MS-PS1-4),(MS-PS1-5)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)

Mathematics –

MP.2 Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5)

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-PS1-1),(MS-PS1-2)*,(MS-PS1-5)

6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. *(MS-PS1-2)*

6.SP.B.5 Summarize numerical data sets in relation to their context (MS-PS1-2)

Connections for to other Common Core Standards at this Grade Level:
L.6-8.6, SL.6-8.1c, SL.6.2

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • to clarify and/or refine a model, an explanation, or an engineering problem. • that require sufficient and appropriate empirical evidence to answer. • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level 6-8	
	No additional CCC for this activity

Correlation Comments	Correlator Initials: ELC
Great activity with some solid links to the above PEs. As a former science teacher, this activity is exactly what I needed to teach these water concepts, but also basic introductory chemistry techniques. The chart is a great idea to help out middle school students who may or may not need the graphic organizer (most would!). It doesn't match up very well with the Common Core Math and ELA, but it shouldn't—it is definitely a science activity, so I don't recommend any changes here.	

Project WET: Just Passing Through

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 2	**Earth's Systems/ Matter and its Interactions**	**Project WET Guide, Page #:** Guide 2.0, p: 163
Brief Lesson Description: In a whole-body activity, students investigate how vegetation affects the movement of water over land surfaces.		
Performance Expectation: 2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*		
Performance Expectation: 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area. [Assessment Boundary: Assessment does not include quantitative scaling in models.]		
Performance Expectation: 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to represent patterns in the natural world. **(2-ESS2-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)* • *Students label on a map areas of erosion they have identified on their school grounds or community.* **Constructing Explanations and Designing Solutions** Compare multiple solutions to a problem. **(2-ESS2-1)** • *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)* • *Students use grade appropriate math to*	**ESS2.A: Earth Materials and Systems** Wind and water can change the shape of the land. **(2-ESS2-1)** • *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students develop a list of processes and actions that could result in the loss of riparian vegetation.* • *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)* • *Students investigate Best Management Practices that can be used to control erosion. (Part III)* • *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)* **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps show where things are located. One can map the shapes and kinds of land and water in any area. **(2-ESS2-2)** • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.*	**Patterns** Patterns in the natural world can be observed. **(2-ESS2-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students use graphs to compare the movement of water through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students graph the movement of water and soil through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).* • *Students use grade appropriate math to graph and compare results between models.* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)* **Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. **(2-PS1-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)* • *Students use grade appropriate math to*

graph and compare results between models.
- *Students investigate Best Management Practices that can be used to control erosion. (Part III)*
- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*
- *Students suggest and describe measure(s) that might be taken to control each erosion location.*

Analyzing and Interpreting Data
Analyze data from tests of an object or tool to determine if it works as intended.
(2-PS1-2)
- *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).*
- *Students use graphs to compare the movement of water through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*
- *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.*
- *Students graph the movement of water and soil through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*
- *Students use grade appropriate math to graph and compare results between models.*
- *Students investigate Best Management Practices that can be used to control erosion. (Part III)*
- *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.*
- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*

- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*
- *Students label on a map areas of erosion they have identified on their school grounds or community.*

ETS1.C: Optimizing the Design Solution
Because there is always more than one possible solution to a problem, it is useful to compare and test designs. **(secondary to 2-ESS2-1)**
- *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)*
- *Students weight the volume of sediment deposited in the model collection containers.*
- *Students time the flow of water through the model collection containers.*
- *Students use grade appropriate math to graph and compare results between models.*
- *Students investigate Best Management Practices that can be used to control erosion. (Part III)*
- *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.*

PS1.A: Structure and Properties of Matter
Different properties are suited to different purposes. **(2-PS1-2)**
- *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)*
- *Students weight the volume of sediment deposited in the model collection containers.*
- *Students time the flow of water through the model collection containers.*
- *Students use grade appropriate math to graph and compare results between models.*
- *Students investigate Best Management Practices that can be used to control erosion. (Part III)*
- *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.*
- *Students suggest and describe measure(s) that might be taken to control each erosion location.*

graph and compare results between models.
- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*
- *Students suggest and describe measure(s) that might be taken to control each erosion location.*

Stability and Change
Things may change slowly or rapidly. **(2-ESS2-1)**
- *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).*
- *Students use graphs to compare the movement of water through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*
- *Students develop a list of processes and actions that could result in the loss of riparian vegetation.*
- *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)*
- *Students use grade appropriate math to graph and compare results between models.*
- *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.*
- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*
- *Students suggest and describe measure(s) that might be taken to control each erosion location.*

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Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World
Developing and using technology has impacts on the natural world. **(2-ESS2-1)**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials.
(2-PS1-2)
- *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates. (Part III)*
- *Students investigate Best Management Practices that can be used to control erosion. (Part III)*
- *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.*
- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*
- *Students suggest and describe measure(s) that might be taken to control each erosion location.*

		Connections to Nature of Science **Science Addresses Questions About the Natural and Material World** Scientists study the natural and material world. **(2-ESS2-1)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)* • *Students investigate Best Management Practices that can be used to control erosion. (Part III)* • *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)* • *Students suggest and describe measure(s) that might be taken to control each erosion location.*

NGSS Common Core Connections:

ELA/Literacy –

RI.2.3	Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS2-1)
RI.2.8	Describe how reasons support specific points the author makes in a text. (2-PS1-2)
RI.2.9	Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1)
W.2.7	Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-2)
W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-2)
SL.2.5	Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-ESS2-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (2-ESS2-1), (2-ESS2-2), (2-PS1-2)
MP.4	Model with mathematics. (2-ESS2-1), (2-ESS2-2), (2-PS1-2)
MP.5	Use appropriate tools strategically. (2-ESS2-1), (2-PS1-2)
2.NBT.3	Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2)
2.MD.10	Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (2-PS1-2)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Decide when to use qualitative vs. quantitative data. • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. • Use quantitative data to compare two alternative solutions to a problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. • Generate and/or compare multiple solutions to a problem
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim. • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Systems and System Models: Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Energy and Matter	Energy and Matter: Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.
Structure and Function	Structure and Function: Students observe the shape and stability of structures of natural and designed objects are related to their function(s).
Stability and Change	Stability and Change: Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** DBB
The content at the heart of Just Passing Through aligns to the 2nd grade NGSS Performance Expectation 2-ESS2-1, but *as written* does not correlate well to the SEP or CCC dimensions - or CCSS connected to the PEs. However, refocusing the existing directions on more student driven outcomes, highlighting additional practices already in the activity and enhancing the rigor of student outcomes as outlined below with the modifications the gray would align and correlate the activity to 2-ESS2-1 **and** 2-ESS2-2 and 2-PS1-2 – **and** most of the CCSS connected to the PEs. The realignment would also open the door for second grade teachers to extend the activity to test the properties of erosion control materials to address PE 2-PS1-1. Also highly suggest reinserting an updated, but simplified version of the list of BMPs that were in the Guide 1.0 version of the	

activity – including a version with pictures of BMP technology that could be posted on the Portal to avoid adding to the guide.

Warm-up –
- *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).*

Part I ~~& Part II~~: The Interaction of Water & Vegetation
- *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)*
- *Students use graphs to compare the movement of water through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*

Part II: Soil Erosion and Deposition of Sediments
- *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)*
- *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.*
- *Students graph the movement of water and soil through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*
- *Students develop a list of processes and actions that could result in the loss of riparian vegetation.*

Part III: Erosion Modelling
- *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part III)*
- *Students weight the volume of sediment deposited in the model collection containers.*
- *Students time the flow of water through the model collection containers.*
- *Students use grade appropriate math to graph and compare results between models.*
- *Students investigate Best Management Practices that can be used to control erosion. (Part III) Suggest reinserting an updated, but simplified version of the list of BMPs that were in Guide 1.0 version of the activity – including a version with pictures of each that could be posted on the Portal to avoid adding to the guide.*
- *Students invite and/or visit a landscape or landscape supply specialist to present samples of erosion control measures for students to observe.*

Part IV: ActionEducation
- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*
- *Students label on a map areas of erosion they have identified on their school grounds or community.*

Resources
Soil Erosion Control and Causes for Kids: http://www.makemegenius.com/science-videos/grade_6/Soil-Erosion-Control-and-Causes-for-kids
Lowe's Erosion Control: http://www.lowes.com/cd_Control+Erosion+in+the+Landscape_1259068825_

Project WET: Just Passing Through

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 4	Earth's Systems: Processes that Shape the Earth	Project WET Guide, Page #: Guide 2.0, p: 163
Brief Lesson Description: In a whole-body activity, students investigate how vegetation affects the movement of water over land surfaces.		
Performance Expectation: 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.		
Performance Expectation: 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Planning and Carrying Out Investigations Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. **(4-ESS2-1)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.* • *Students use their erosion models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students weight the volume of sediment deposited in the model collection containers.* • *Students use grade appropriate math techniques to compare results between models and variables tested.* • *Students investigate Best Management Practices that can be used to control erosion. (Part III)* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up).* **Constructing Explanations and Designing Solutions** Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. **(4-ESS3-2)** • *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated*	**ESS2.A: Earth Materials and Systems** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. **(4-ESS2-1)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students write and/or discuss the potential consequences – pro and con - of soil erosion and deposition of sediments.(Part III)* • *Students use their erosion models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)* **ESS2.E: Biogeology** Living things affect the physical characteristics of their regions. **(4-ESS2-1)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)* • *Students use graphs to compare the movement of water through sites that have and that lack*	**Cause and Effect** Cause and effect relationships are routinely identified, tested, and used to explain change. **(4-ESS2-1), (4-ESS3-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students use their erosion models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students use grade appropriate math to graph and compare results between models.* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)* • *Students design a landscape using BMPs to control erosion (Wrap Up).* ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. **(4-ESS3-2)** • *Students write and/or discuss the potential consequences – pro and con - of soil erosion and deposition of sediments.* • *Students investigate Best Management Practices that can be used to control erosion. (Part III)* • *Students inventory their school grounds*

slopes for each simulation. • *Students use their erosion models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students use grade appropriate math to graph and compare results between models.* • *Students investigate Best Management Practices that can be used to control erosion. (Part lll)* • *Students design a landscape using BMPs to control erosion (Wrap Up).*	*plant cover (Part II, step 2 and Part III, steps 4 and 5).* • *Students write an explanation describing the flow of water on vegetated and unvegetated slopes, (Part l)* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part Ill)* • *Students write and/or discuss the potential consequences – pro and con - of soil erosion and deposition of sediments.(Part III)* • *Students investigate Best Management Practices that can be used to control erosion. (Part lll)* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up).* • *Students design a landscape using BMPs to control erosion (Wrap Up).* **ESS3.B: Natural Hazards** A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. **(4-ESS3-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part Ill)* • *Students write an explanation describing the interaction of soil and water on vegetated and unvegetated slopes.* • *Students write and/or discuss the potential consequences – pro and con - of soil erosion and deposition of sediments.(Part III)* • *Students investigate Best Management Practices that can be used to control erosion. (Part lll)* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up).* • *Students design a landscape using BMPs to control erosion (Wrap Up).* **ETS1.B: Designing Solutions to Engineering Problems** Testing a solution involves investigating how well it performs under a range of likely conditions. **(secondary to 4-ESS3-2)** • *Students develop simple models to test the affects of ground cover, vegetation and slope on erosion rates.(Part lll)* • *Students use their erosion models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students use grade appropriate math techniques to compare results between models and variables tested.* • *Students investigate Best Management Practices that can be used to control erosion. (Part lll)*	*or community to assess areas likely to have erosion problems (Wrap Up).* • *Students measure and map areas of erosion on their school grounds or community.* • *Students design a landscape using BMPs to control erosion (Wrap Up).*

NGSS Common Core Connections:	
ELA/Literacy –	
RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1)
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, paraphrase, and categorize information, and provide a list of sources. (4-ESS2-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (4-ESS2-1),(4-ESS3-2)
MP.4	Model with mathematics. (4-ESS2-1),(4-ESS3-2)
MP.5	Use appropriate tools strategically. (4-ESS2-1)
4.MD.A	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments | **Correlator Initials:** DBB

The content at the heart of Just Passing Through correlates to the 4th grade NGSS Performance Expectations 4-ESS2-1 and 4-ESS3-2, but not very well to the SEP or CCC dimensions - or CCSS connected to either PE. The suggested alignment of the activity below and modifications the gray would help correlated the activity to most of these elements.

Warm-up –

- *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope.*

Part I ~~& Part II~~: The Interaction of Water & Vegetation

- *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)*
- *Students use graphs to compare water's movement through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*

Part III: Soil Erosion and Deposition of Sediments

- *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)*
- *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.*
- *Students graph the movement of water and soil through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*
- *Students write and/or discuss the potential consequences – pro and con - of soil erosion and deposition of sediments.*

Part lV: Erosion Modelling

- *Students use their erosion models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.*
- *Students weight the volume of sediment deposited in the model collection containers.*
- *Students use grade appropriate math techniques to compare results between models and variables tested.*
- *Students investigate Best Management Practices that can be used to control erosion. (Part lll) Suggest reinserting an updated, but simplified version of the list of BMPs that were in the Giude 1.0 version of the activity – including a version with pictures of each that could be posted on the Portal to avoid adding to the guide.*

Part IV: ActionEducation

- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up).*
- *Students measure and map areas of erosion on their school grounds or community.*
- *Students design a landscape using BMPs to control erosion (Wrap Up).*

Resources

Soil Erosion Control and Causes for Kids: http://www.makemegenius.com/science-videos/grade_6/Soil-Erosion-Control-and-Causes-for-kids

Lowe's Erosion Control: http://www.lowes.com/cd_Control+Erosion+in+the+Landscape_1259068825_

Project WET: Just Passing Through

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Ecosystems: Interactions, Energy, and Dynamics	Project WET Guide, Page #: Guide 2.0, p: 163
Brief Lesson Description: In a whole-body activity, students investigate how vegetation affects the movement of water over land surfaces.		
Performance Expectation: MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.		
Performance Expectation: MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop and use a model to describe phenomena. **(MS-ESS2-1)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students develop simple models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students use grade appropriate math techniques to compare results between models and variables tested.* • *Students label on a map areas of erosion they have identified on their school grounds or community.* • *Students design a landscape using BMPs to control erosion (Wrap Up).* **Constructing Explanations and Designing Solutions** Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. **(MS-ESS2-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope.* • *Students simulate how water flows down*	**ESS2.A: Earth's Materials and Systems** All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. **(MS-ESS2-1)** ***Supplemental DCI PS1.A*** The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **(MS-ESS2-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope. (Warm-Up).* • *Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students construct an explanation based on evidence using multimedia components for how the processes of erosion and deposition have changed Earth's surface at varying time and spatial scales.* • *Students develop simple models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up)*	**Scale Proportion and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **(MS-ESS2-2)** • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students compare water's movement through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).* • *Students develop simple models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up).* **Stability and Change** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. **(MS-ESS2-1)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope.* • *Students construct an explanation based on evidence using multimedia components for how the processes of erosion and deposition have changed Earth's surface at varying time and spatial scales* • *Students develop simple models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students use grade appropriate math techniques to compare results between models and variables tested.* • *Students investigate Best Management Practices that can be used to control erosion. (Part III)*

a vegetated vs. an unvegetated slope and into a stream (Part I) • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students construct an explanation based on evidence using multimedia components for how the processes of erosion and deposition have changed Earth's surface at varying time and spatial scales* • *Students develop simple models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students use grade appropriate math techniques to compare results between models and variables tested.* • *Students investigate Best Management Practices that can be used to control erosion. (Part III)* • *Students design a landscape using BMPs to control erosion (Wrap Up).*	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. **(MS-ESS2-2)** • *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope.* • *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)* • *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.* • *Students construct an explanation based on evidence using multimedia components for how the processes of erosion and deposition have changed Earth's surface at varying time and spatial scales.* • *models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.* • *Students investigate Best Management Practices that can be used to control erosion. (Part III)* • *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up).* • *Students measure and map areas of erosion on their school grounds or community.*	• *Students design a landscape using BMPs to control erosion (Wrap Up).*

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2)

SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-ESS2-1),(MS-ESS2-2)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (MS-ESS2-2)

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Create algorithms (a series of ordered steps) to solve a problem. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Energy and Matter	Energy and Matter: Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments | **Correlator Initials:** DBB

The content at the heart of Just Passing Through correlates to the MS grade NGSS Performance Expectations MS-ESS2-1 and MS-ESS2-2, but as currently written only has weak correlation to MS-ESS2-2 and none to the CCSS connected to either PE. The suggested revised alignment of the activity below and modifications the gray would help correlated the activity to both PEs and all but one of the connecting CCSS. Most of the modifications are already in the activity and the modifications merely make the activity more student driven and add more rigor as required by NGSS.

There is a High School NGSS PE HS-ESS2-5 (*Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.)* that sounds like a perfect fit for *'Just Passing Through,'* but the activity does not meet the level of rigor to correlate – All aspects of the dimensions are zeroed in on much more detailed experiments, math analysis and higher level science content than our activity has even if the suggested modifications here are adopted.

Warm-up –
- *Students compare photographs of vegetated and unvegetated slopes and predict how rainfall could affect each slope.*

Part I ~~& Part II~~: The Interaction of Water & Vegetation
- Students simulate how water flows down a vegetated vs. an unvegetated slope and into a stream (Part I)
- Students *use graphs to* compare water's movement through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).

Part II (currently Part III): Soil Erosion and Deposition of Sediments
- *Students simulate the interaction of soil and water on a vegetated vs. an unvegetated slope. (Part III)*
- *Students draw a diagram mapping and describing the movement of water and soil particles on the vegetated and unvegetated slopes for each simulation.*
- *Students graph the movement of water and soil through sites that have and that lack plant cover (Part II, step 2 and Part III, steps 4 and 5).*
- *Students construct an explanation based on evidence using multimedia components for how the processes of erosion and deposition have changed Earth's surface at varying time and spatial scales.*

Part Iii: Erosion Modelling

- *Students develop simple models to test factors influencing the rate of erosion – i.e., slope, ground materials, volume and/or length of rainfall, BMPs, etc.*
- *Students weight the volume of sediment deposited in the model collection containers.*
- *Students use grade appropriate math techniques to compare results between models and variables tested.*
- *Students investigate Best Management Practices that can be used to control erosion. (Part III)*
- *Suggest reinserting an updated, but simplified version of the list of BMPs that were in the Guide 1.0 version of the activity – including a version with pictures of each that could be posted on the Portal to avoid adding to the guide.*

Part IV: ActionEducation

- *Students inventory their school grounds or community to assess areas likely to have erosion problems (Wrap Up).*
- *Students measure and map areas of erosion on their school grounds or community.*
- *Students design a landscape using BMPs to control erosion (Wrap Up).*

Resources

Soil Erosion Control and Causes for Kids: http://www.makemegenius.com/science-videos/grade_6/Soil-Erosion-Control-and-Causes-for-kids

Lowe's Erosion Control: http://www.lowes.com/cd_Control+Erosion+in+the+Landscape_1259068825_

Project WET: The Life Box

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: Kindergarten</td><td>From Molecules to Organisms: Structures and Processes/ Earth and Human Activity</td><td>Project WET Guide, Page #:
Guide 2.0, p. 69</td></tr>
<tr><td colspan="3">Brief Lesson Description: Through a thought-provoking activity, students learn plants and animals depend on four essential, interdependent factors for life and how the four factors work together in a system.</td></tr>
<tr><td colspan="3">Performance Expectation: K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.</td></tr>
<tr><td colspan="3">Performance Expectation: K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.</td></tr>
<tr><th>Science & Engineering Practice(s)</th><th>Disciplinary Core Idea(s)</th><th>Crosscutting Concept(s)</th></tr>
<tr><td>Developing and Using Models
Use a model to represent relationships in the natural world. (K-ESS3-1)
• Students identify four essential factors of life and how they work together (steps 3 and 5).
• Students read or listen to stories describing how plants and animals use the four factors.
• Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).

Analyzing and Interpreting Data
Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-LS1-1)
• Students discuss the characteristics and needs of living organisms. (Warm-up)
• Students identify four essential factors of life and how they work together (steps 3 and 5).
• Students read or listen to stories describing how plants and animals use the four factors.
• Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).
....
Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Scientists look for patterns and order when making observations about the world. (K-LS1-1)
• Students identify four essential factors of life and how they work together (steps 3 and 5).
• Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).</td><td>LS1.C: Organization for Matter and Energy Flow in Organisms
All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)
• Students discuss the characteristics and needs of living organisms. (Warm-up)
• Students identify four essential factors of life and how they work together (steps 3 and 5).
• Students read or listen to stories describing how plants and animals use the four factors.
• Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).

ESS3.A: Natural Resources
Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1)
• Students discuss the characteristics and needs of living organisms. (Warm-up)
• Students identify four essential factors of life and how they work together (steps 3 and 5).
• Students read or listen to stories describing how plants and animals use the four factors.
• Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).</td><td>Patterns
Patterns in the natural and human designed world can be observed and used as evidence. (K-LS1-1)
• Students identify four essential factors of life and how they work together (steps 3 and 5).
• Students read or listen to stories describing how plants and animals use the four factors.
• Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).

Systems and System Models
Systems in the natural and designed world have parts that work together. (K-ESS3-1)
• Students identify four essential factors of life and how they work together (steps 3 and 5).
• Students read or listen to stories describing how plants and animals use the four factors.
• Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).</td></tr>
</table>

NGSS Common Core Connections:
ELA/Literacy –

W.K.7	Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-LS1-1)
SL.K.5	Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Cause and Effect	Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Energy and Matter	Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.

Correlation Comments	**Correlator Initials:** DBB
The Life Box generally correlates to the Kindergarten NGSS Performance Expectations K-LS2-1 and K-ESS3-1 *as written*, but integrating the modifications shaded in grey *could* strengthen correlations. Suggest asking those with ECE expertise on P & P WET team and in network to suggest additional modifications for alignment appropriate to the grade level – especially for math, as I cannot see any correlation to the connecting CCSS math.	

Project WET: The Life Box

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 2	Ecosystems: Interactions, Energy, and Dynamics	Project WET Guide, Page #: Guide 2.0, p. 69
Brief Lesson Description: Through a thought-provoking activity, students learn plants and animals depend on four essential, interdependent factors for life and how the four factors work together in a system.		
Performance Expectation: 2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Planning and Carrying Out Investigations Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. **(2-LS2-1)** • *Students create an experiment to prove or disprove that water, sunlight, air and soil are essential for life. (Extension)* • *Students describe and compare the results of their experiments, including drawings or other visual displays.*	**LS2.A: Interdependent Relationships in Ecosystems** Plants depend on water and light to grow. **(2-LS2-1)** • *Students discuss the needs of living organisms. (Warm-up)* • *Students identify four essential factors of life and how they work together (steps 3 and 5).* • *Students read or listen to stories describing how plants and animals use the four factors.* • *Students draw or label a picture and describe how living things use the four factors of life (Wrap Up).* • *Students create an experiment to prove or disprove that water, sunlight, air and soil are essential for life. (Extension)* • *Students describe and compare the results of their experiments, including drawings or other visual displays.*	**Cause and Effect** Events have causes that generate observable patterns. **(2-LS2-1)** • *Students read or listen to stories describing how plants and animals use the four factors.* • *Students draw or label a picture and describe how living things use the four factors of life (Wrap-Up).* • *Students create an experiment to prove or disprove that water, sunlight, air and soil are essential for life. (Extension)* • *Students describe and compare the results of their experiments, including drawings or other visual displays.*

NGSS Common Core Connections:

ELA/Literacy –

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS2-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-LS2-1)

SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-LS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (2-LS2-1)
MP.4 Model with mathematics. (2-LS2-1)
MP.5 Use appropriate tools strategically. (2-LS2-1)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Energy and Matter	Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.

Correlation Comments	**Correlator Initials:** DBB
The Life Box *does not* correlate to the 2nd grade NGSS Performance Expectations 2-LS2-1 *as written*, but *could* be aligned to do so by integrating the current extension of suggestion for students to plan an experiment to see if plants need the four factors to grow and including more use of drawing and math into activity – Some of these modifications are in grey, but suggest asking those with ECE expertise on P & P WET team and in network to suggest additional modifications for alignment appropriate to the grade level.	

Project WET: Macroinvertebrate Mayhem

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	Earth and Human Activity/Ecosystems: Interactions, Energy, and Dynamics	Project WET Guide, Page #: Guide 2.0, p. 343
Brief Lesson Description: Students play a game of tag to simulate the effects of environmental stressors on macroinvertebrate populations.		
Performance Expectation: 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to describe phenomena. **(5-LS2-1)** • *Students engage in a simulation to observe changes in a stream when an environmental stressor is introduced. (Part II)* • *Students graph the results of the simulation and calculate the ratio of tolerant, intolerant and facultative organisms in each round of the activity.* • *Students develop a food web demonstrating the flow of energy in the stream ecosystem based on the information provided by other student presentations.* • *Students develop a chart aggregating macroinverebrates with similar tolerances and characteristics.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • *Students work in teams to investigate the characteristics of a macroinvertebrate organism, including a diagram of its role in the aquatic food chain and what stream conditions it needs to survive (Part I, steps 2 and 3; Wrap Up).* • *Students develop a food web demonstrating the flow of energy in the stream ecosystem based on the information provided by other student presentations.* • *Students develop a chart aggregating macroinverebrates with similar tolerances and characteristics.* • *Students identify and research the organisms observed in their macroinvertebrate survey to identify food chain and pollution tolerance relationships.*	**ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Students analyze a stream based on a visual assessment (Warm-Up).* • *Students brainstorm a list of environmental stressors and discuss how they can affect the health of a stream. (Warm Up).* • *Students engage in a simulation to observe changes in a stream when an environmental stressor is introduced. (Part II)* • *Students plan and conduct a macroinvertebrate survey on a stream ecosystem.* • *Students record observations of physical a biological elements of the stream ecosystem.* • *Students identify and research the organisms observed in their macroinvertebrate survey to identify food chain and pollution tolerance relationships.* • *Students graph the results of their survey and calculate the ratio of tolerant, intolerant and facultative organisms in each round of the activity.* • *Students use evidence to interpret stream quality. (Wrap-Up)* **LS2.A: Interdependent Relationships in Ecosystems** The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers."	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-LS2-1), (5-ESS3-1)** • *Students analyze a stream based on a visual assessment (Warm-Up).* • *Students brainstorm a list of environmental stressors and discuss how they can affect the health of a stream. (Warm-Up).* • *Students engage in a simulation to observe changes in a stream when an environmental stressor is introduced. (Part II)* • *Students graph the results of the simulation and calculate the ratio of tolerant, intolerant and facultative organisms in each round of the activity.* • *Students work in teams to investigate the characteristics of a macroinvertebrate organism, including role in the aquatic food chain and what stream conditions they need to survive (Part I, steps 2 and 3; Wrap-Up).* • *Students work in teams to investigate the characteristics of a macroinvertebrate organism, including a diagram of its role in the aquatic food chain and what stream conditions it needs to survive (Part I, steps 2 and 3; Wrap-Up).* • *Students develop a food web demonstrating the flow of energy in the stream ecosystem based on the information provided by other student presentations.* • *Students develop a chart aggregating macroinverebrates with similar tolerances and characteristics.* • *Students use evidence to interpret stream quality. (Wrap-Up)*

- *Students use evidence to interpret stream quality. (Wrap Up)*

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
Science explanations describe the mechanisms for natural events. **(5-LS2-1)**

- *Students engage in a simulation to observe changes in a stream when an environmental stressor is introduced. (Part ll)*
- *Students write an explanation to describe what happened to the macroinvertebrate populations in the simulation.*
- *Students develop a food web demonstrating the flow of energy in the stream ecosystem and the role of their organism within the web.*
- *Students develop an argument based on evidence how their organism is or is not an indicator of stream quality (Wrap-Up)*
- *Students modify their food web demonstrating the flow of energy in the stream ecosystem based on the information provided by other student presentations.*
- *Students interpret stream quality based on the diversity and types of organisms found there (Wrap-Up)*
- *Students invite a local stream monitoring organization to discuss the health of their local stream and the student interpretation of health based on their macroinvertebrate study.*

Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. **(5-LS2-1)**

- *Students analyze a stream based on a visual assessment (Warm-Up).*
- *Students brainstorm a list of environmental stressors and discuss how they can affect the health of a stream. (Warm Up).*
- *Students engage in a simulation to observe changes in a stream when an environmental stressor is introduced. (Part ll)*
- *Students use evidence to write an explanation describing impacts to the macroinvertebrate populations in the simulation.*
- *Students work in teams to investigate the characteristics of a macroinvertebrate organism, including a diagram of its role in the aquatic food chain and what stream conditions it needs to survive (Part I, steps 2 and 3; Wrap-Up).*
- *Students develop a food web demonstrating the flow of energy in the stream ecosystem based on the information provided by other student presentations.*
- *Students develop a chart aggregating macroinverebrates with similar tolerances and characteristics.*
- *Students record observations of physical a biological elements of the stream ecosystem.*
- *Students identify and research the organisms observed in their macroinvertebrate survey to identify food chain and pollution tolerance relationships.*
- *Students graph the results of their survey and calculate the ratio of tolerant, intolerant and facultative organisms in each round of the activity.*
- *Students use evidence to interpret stream quality. (Wrap-Up)*

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
Science findings are limited to questions that can be answered with empirical evidence.
(5-ESS3-1)

- *Students develop questions to research regarding what happened in the simulation.*
- *Students work in teams to investigate the characteristics of a macroinvertebrate organism, including a diagram of its role in the aquatic food chain and what stream conditions it needs to survive (Part I, steps 2 and 3; Wrap Up).*
- *Students develop a food web demonstrating the flow of energy in the stream ecosystem based on the information provided by other student presentations.*
- *Students develop a chart aggregating macroinverebrates with similar tolerances and characteristics.*
- *Students develop an argument based on evidence how their organism is or is not an indicator of stream quality (Wrap-Up)*

NGSS Common Core Connections:
ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.(5-ESS3-1), (5-LS2-1)
RI.5.9.a,b	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-LS2-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-ESS3-1), (5-LS2-1)
MP.4	Model with mathematics. (5-ESS3-1), (5-LS2-1)

Connections to other Common Core Standards at this Grade Level: SL.3-8.1; SL.3-8.4; W.3-8.7

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Energy and Matter	Energy and Matter: Students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

Macroinvertebrate Mayhem does not correlate well to the 5th grade NGSS Performance Expectations LS2-1 and 5-ESS3-1 *as written*, but could if the activity is revised to include graphing and calculating to study the results of each round in the activity, instructing students to research and develop an aquatic food web demonstrating the role of macroinvertebrates within this system and building an argument based on evidence on the use of any given macroinvertebrate can be used as an indicator of water quality.

Revising the flow of the activity to get the activity up front and using it to build student inquiry will not only align the activity to the 5th Grade NGSS dimensions, but to ALL of the connecting CCSS and additional NGSS SEPs and CCCs for this grade band.

Adding these changes will also open the door for MS teachers to use the activity to begin building student proficiency toward MS PEs MS-LS2-2, MS-LS2-3 and MS-LS2-5. There would need to be more extensive additions to the activity to fully align with these additional MS PEs, but the fairly simple addition of basic math, developing a food web model and investigating the use of macroinvertebrates as indicators would greatly expand the ability of this activity to be utilized in 5th and MS grades as noted above and in the suggested revision outline below.

Warm-up

- *Students analyze a stream based on a visual (Warm Up)(assessment).*
- *Students brainstorm a list of environmental stressors and discuss how they can affect the health of a stream. (Warm Up).*

Part I:

- *Students engage in a simulation to observe changes in a stream when an environmental stressor is introduced. (Part ll)*
- *Students graph the results of the simulation and calculate the ratio of tolerant, intolerant and facultative organisms in each round of the activity.*
- *Students use evidence to write an explanation describing impacts to the macroinvertebrate populations in the simulation.*
- *Students develop questions to research regarding what happened in the simulation.*

Part ll:

- *Students work in teams to investigate the characteristics of a macroinvertebrate organism, including a diagram of its role in the aquatic food chain and what stream conditions it needs to survive (Part I, steps 2 and 3; Wrap Up).*
- *Students develop a food web demonstrating the flow of energy in the stream ecosystem based on the information provided by other student presentations.*
- *Students develop a chart aggregating macroinverebrates with similar tolerances and characteristics.*
- *Students develop an argument based on evidence how their organism is or is not an indicator of stream quality.*

Part IV: ActionEducation

- *Students plan and conduct a macroinvertebrate survey on a stream ecosystem.*
- *Students record observations of physical and biological elements of the stream ecosystem.*
- *Students identify and research the organisms observed in their macroinvertebrate survey to identify food chain and pollution tolerance relationships.*
- *Students graph the results of their survey and calculate the ratio of tolerant, intolerant and facultative organisms in each round of the activity.*
- *Students use evidence to interpret stream quality. (Wrap-Up)*

Project WET: Make-A-Mural

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extensions section of the activity.*

Grade: 5	Earth's Systems	Project WET Guide, Page #: Guide 2.0, p. 515
Brief Lesson Description: Students create a mural depicting various aspects of the watershed in which they live, including its landscape, people, cultures and plant and animal residents.		
Performance Expectation: 5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Have groups select art materials and begin working on their mural segments. (Part I, Step 6)* • *When all groups have contributed to each segment, have students tape them together from left to right, being careful to match the corners and the river line. (Part I, Step 7)*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** • *Ask students to name the components of a watershed (e.g., plants, animals, people, cities). (Warm Up)* • *When you have an exhaustive list, ask students in small groups to develop the definition of a watershed. (Warm Up)* • *Have students share their group definitions and work together to develop a class's definition. (Warm Up)* • *Read to them the complete definition of a watershed from the Background and compare it to the class's definition. (Warm Up)* • *Have students research their topic(s) for their local watershed using notes from the Warm Up class discussion, books, the Internet, encyclopedias, interviews with experts, parents and so forth.(Part I, Step 3)* • *Ask students to write short essays or journal entries interpreting their mural(s). (Extension)*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1)** • *Ask students to name the components of a watershed (e.g., plants, animals, people, cities). (Warm Up)* • *When you have an exhaustive list, ask students in small groups to develop the definition of a watershed. (Warm Up)* • *Have students share their group definitions and work together to develop a class's definition. (Warm Up)* • *Read to them the complete definition of a watershed from the Background and compare it to the class's definition. (Warm Up)* • *Have students research their topic(s) for their local watershed using notes from the Warm Up class discussion, books, the Internet, encyclopedias, interviews with experts, parents and so forth. (Part I, Step 3)* • *Ask students to write short essays or journal entries interpreting their mural(s). (Extension)*
NGSS Common Core Connections: ***ELA/Literacy -*** **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a **problem efficiently. (5-ESS2-1),(5-ESS2-2)** **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2) **Connections to other Common Core Standards at this Grade Level:** ***ELA***: RI.5-12.4; RST.6-12.3; RST.6-12.4; RST.6-10.9; SL.3-12.4; W.3-12.7; ***Math***: 2.MD.1; 4.G.1		

Additional SEP Connections: Grade 5:	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

Additional Crosscutting Concepts by Grade Level 5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	**Correlator Initials:** MJW

Possible Alignments

K-ESS2-1, 5-ESS3-1, MS-ESS3, —it is not very clear in this activity what "issues" mean. Since issues could easily include human impact on the environment these standards could be addressed, however they are not explicitly aligned because alignment depends on the issues addressed (and whether or not Part II of the activity is completed). (These are examples of standards that could align depending on issues chosen—not exhaustive)

K-ESS3-1—This standard is fitting to this activity but at this level the activity would need to be simplified.

2-LS4-1—Close, but since the emphasis for this standard is on comparing diversity in <u>different habitats</u> it is not an ideal fit.
2-ESS2-2—possible fit, but focus is on maps.

*5-ESS2-1**
This activity could be stronger on the science side if Wrap Up questions pertained more to watershed content than art.

Project WET: Molecules in Motion

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** Blue text represents the Extension section of the activity.*

Grade: **2**	**Topic: Matter and Its Interactions**	**Project WET Guide, Page #:** Guide 2.0, p. 33
Brief Lesson Description: This activity brings water molecules up to size (student size!) by physically involving students in simulating molecular movements in each of water's physical states (solid, liquid, gas).		
Performance Expectation: 2-PS1-4: Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). Construct an argument with evidence to support a claim. **(2-PS1-4)** • *Students write down or draw pictures of what happens to an ice cube on a window ledge as the weather turns warmer. Discuss their views and collect their papers. (Warm Up)* • *Students identify the conditions needed for each state of matter to exist. (Warm Up)* • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state. (Wrap Up)* …………………………………………………………………… ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** Scientists search for cause and effect relationships to explain natural events. **(2-PS1-4)**	**PS1.B: Chemical Reactions** Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. **(2-PS1-4)** • *Students identify the conditions needed for each state of matter to exist. (Warm Up)* • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)*	**Cause and Effect** Events have causes that generate observable patterns. **(2-PS1-4)** • *Students write down or draw pictures of what happens to an ice cube on a window ledge as the weather turns warmer. Discuss their views and collect their papers. (Warm Up)* • *Students identify the conditions needed for each state of matter to exist. (Warm Up)* • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state. (Wrap Up)*
NGSS Common Core Connections: ***ELA/Literacy –*** **RI.2.1** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text. *(2-PS1-4)* **RI.2.3** Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-PS1-4) **RI.2.8** Describe how reasons support specific points the author makes in a text. *(2-PS1-2),(2-PS1-4)*		

W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., because, and, also) to connect opinion and reasons, and provide a concluding statement or section. (2-PS1-4)

Mathematics –

Connections to other Common Core Standards at this Grade Level: W.2.2, W.2.3

Additional SEP Connections: Grades K-2	
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Energy and Matter	Energy and Matter: Students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.
Stability and Change	Stability and Change: Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** ELC

Although this activity was not intended to show how states of matter could be reversed, that is certainly included as part of this activity. The "construct an argument" portion of the PE could be stronger in the activity, if students are asked to write more or provide more in-depth evidence about the changes that they draw or write about. This is easily added upon or insisted upon by teachers. This PE also addresses that some changes cannot be reversed, but this activity does not address that portion of the PE.

If the idea of where water is located on Earth in solid or liquid form is brought into a discussion following this activity, then 2-ESS3-3 would also apply.

But, I couldn't come up with a logical placement for adding this into the activity that wouldn't just be extra information and too much for this concept The activity is a great stand-alone activity about molecular motion and really should be used independently *before* introducing the idea of where on the Earth's surface do we find water and in what state.

Project WET: Molecules in Motion

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Grade: 4	**Topic: Energy**	**Project WET Guide, Page #:** Guide 2.0, p. 33
Brief Lesson Description: This activity brings water molecules up to size (student size!) by physically involving students in simulating molecular movements in each of water's physical states (solid, liquid, gas).		
Performance Expectation: 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, heat, light and electric current.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. **(4-PS3-2)** • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state, following the activity. (Wrap Up)*	**PS3.A: Definitions of Energy** Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **(4-PS3-2), (4-PS3-3)** **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. **(4-PS3-2), (4-PS3-3)** • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state, following the activity. (Wrap Up)* Light also transfers energy from place to place. **(4-PS3-2)** Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. **(4-PS3-2)**	**Energy and Matter** Energy can be transferred in various ways and between objects. **(4-PS3-1), (4-PS3-2), (4-PS3-3), (4-PS3-4)** • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state, following the activity. (Wrap Up)*
NGSS Common Core Connections: ***ELA/Literacy –*** **W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-PS3-3),(4-PS3-4) **W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4) ***Mathematics –*** **Connections to other Common Core Standards at this Grade Level:** None		

Additional SEP Connections: Grades 3-5	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.

Correlation Comments	**Correlator Initials:** ELC
This particular PE is all about the energy transfer and that heat (and others, not found in this activity) can be transferred. Our WET activity is about heat being transferred to water molecules in order to change states of matter. There is nice link to the energy part of this for 4th grade and we'll see a different emphasis for the 5th grade PE.	

Project WET: Molecules in Motion

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Grade: **5**	**Topic: Matter and its Interactions**	**Project WET Guide, Page #:** Guide 2.0, p. 33
Brief Lesson Description: This activity brings water molecules up to size (student size!) by physically involving students in simulating molecular movements in each of water's physical states (solid, liquid, gas).		
Performance Expectation: 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to describe phenomena. **(5-PS1-1)** • *Students write down or draw pictures of what happens to an ice cube on a window ledge as the weather turns warmer. Discuss their views and collect their papers. (Warm Up)* • *Students identify the conditions needed for each state of matter to exist. (Warm Up)* • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state, following the activity. (Wrap Up)*	**PS1.A: Structure and Properties of Matter** Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. **(5-PS1-1)** The amount (weight) of matter is conserved when it changes. • *Students write down or draw pictures of what happens to an ice cube on a window ledge as the weather turns warmer. Discuss their views and collect their papers. (Warm Up)* • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state, following the activity. (Wrap Up)*	**Scale, Proportion, and Quantity** Natural objects exist from the very small to the immensely large. **(5-PS1-1)** • *Students write down or draw pictures of what happens to an ice cube on a window ledge as the weather turns warmer. Discuss their views and collect their papers. (Warm Up)* • *Students pretend to be water molecules in solid, liquid, or gas form and react to heat (red flashlight) or loss of heat (blue flashlight). (The Activity)* • *Students write or draw their representation of water in each state, following the activity. (Wrap Up)*

NGSS Common Core Connections:
ELA/Literacy –
RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve problem efficiently. (5-PS1-1)
Mathematics –
MP.2 Reason abstractly and quantitatively. (5-PS1-1),(5-PS1-2),(5-PS1-3)
MP.4 Model with mathematics. (5-PS1-1),(5-PS1-2),(5-PS1-3)
5.NBT.A.1 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-PS1-1)
5.NF.B.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1)
5.MD.C.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1)
5.MD.C.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. (5-PS1-1)

Connections to other Common Core Standards at this Grade Level:
None

Additional SEP Connections: Grades 3-5	
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	**Correlator Initials:** ELC
This particular PE is all about the development of a model to show that matter is made of particles too small to be seen—models can be indicated in two ways—the drawings in both the Warm Up and Wrap Up and especially during the Activity portion are all models. My only other thought about this activity and this 5th grade PE that would add in more of the Nature of Science idea, might be to ask students to apply this idea about molecular movement to other situations like the balloon example mentioned above in the DCI. The Extensions as they are are all about using music or collage techniques, but what about another Extension, asking them to apply this model to other situations? I think that would be a good Extension for the upper elementary and in this case, 5th grade.	

Project WET: My Water Footprint

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Grade: 5	**Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p.441
Brief Lesson Description: Students learn about water footprints and construct a "Water Meter" to keep track of their personal water use.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Obtaining, Evaluating, and Communicating Information Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • *Do students believe they have accurately represented the total amount of water used? Remind them of indirect uses, such as the water required to grow their food, make their paper, manufacture their blue jeans, produce energy for their use and so forth. What would happen to the water meter if indirect uses of water were included? (Wrap Up) Research indirect water use amounts and add to water meter.* • *Students may want to investigate ways they can reduce their water consumption. They can compare water use before and after implementing water conservation practices. (Extension)*	**ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Individually and then as a group, ask students to list the ways they use water and write each item on their left footprint. (Warm Up)* • *Explain that every time students use water, they should slide the ribbon to indicate the number of gallons or liters used. (Activity, Step 2)* • *Ask students to record their water use on a daily bar graph and supplement their measurements with journal entries. (Activity, Step 3)* • *Students may think of other water uses not listed in the data table. (Activity, Step 4)* • *Do students believe they have accurately represented the total amount of water used? Remind them of indirect uses, such as the water required to grow their food, make their paper, manufacture their blue jeans, produce energy for their use and so forth. What would happen to the water meter if indirect uses of water were included? (Wrap Up)* • *Distribute the right footprints to your students and ask them to suggest ideas for using less water, but still meeting their water needs. Add ideas for the classroom and school to make a connection with others. (Wrap Up)* • *Have students conduct research on corporate water footprints to determine how manufacturers are using, managing and protecting water. Why do corporations keep track of how water is used? How do they report water use? (Extension)* • *Students may want to investigate ways*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS3-1)** .... ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Prior to starting the activity, ask students to estimate how many gallons of water they think they use in a day. (Activity)* • *Have students construct a Daily Use Water Meter according to the directions found later in the activity. Tell them that for one week they are going to keep track of how much water they use each day. (Activity, Step 1)* • *Explain that every time students use water, they should slide the ribbon to indicate the number of gallons or liters used. (Activity, Step 2)* • *After students finish the activity compare their estimates with their actual data. Discuss the importance of scientific observation and collection of evidence. (Wrap Up)*

	they can reduce their water consumption. They can compare water use before and after implementing water conservation practices. (Extension)	

NGSS Common Core Connections:
Mathematics -
MP.2 Reason abstractly and quantitatively. (5-ESS3-1)

Connections to other Common Core Standards at this Grade Level: ***ELA*****:** RST.6-8.8; W.3-5.8 ***Math*****:** 3.MD.3; 6.NS.3

Additional SEP Connections: Grade 5	
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.

Additional Crosscutting Concepts by Grade Level 5	
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.

Correlation Comments	**Correlator Initials:** MJW
Possible Alignments *K-ESS3-3—if simplified, this could fit here content wise* *This activity supports the following PEs* *5-ESS3-1*—content (DCI) fits* *MS-ESS3-3*—needs to incorporate more info on the big picture of water use and impact to the planet—WHY conserve water?*	

Project WET: My Water Footprint

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** Blue text represents the Extension section of the activity.*

Grade: MS	**Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p.441
Brief Lesson Description: Students learn about water footprints and construct a "Water Meter" to keep track of their personal water use.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • *Distribute the right footprints to your students and ask them to suggest ideas for using less water, but still meeting their water needs. Add ideas for the classroom and school to make a connection with others. For example, students could do a water audit to determine how water is used in the school and then suggest ideas for reducing school water use. When the students have completed their entries, have each student carefully tape right water footprints slightly in front of their left footprint. (Wrap Up)* • *Have students conduct research on corporate water footprints to determine how manufacturers are using, managing and protecting water. Why do corporations keep track of how water is used? How do they report water use? (Extension)* • *Students may want to investigate ways they can reduce their water consumption. They can compare water use before and after implementing water conservation practices. (Extension)*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Distribute the right footprints to your students and ask them to suggest ideas for using less water, but still meeting their water needs. Add ideas for the classroom and school to make a connection with others. For example, students could do a water audit to determine how water is used in the school and then suggest ideas for reducing school water use. When the students have completed their entries, have each student carefully tape right water footprints slightly in front of their left footprint. (Wrap Up) Discuss why reducing water use is important—how does water use impact Earth?* Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-3), (MS-ESS3-4)** • *Distribute the right footprints to your students and ask them to suggest ideas for using less water, but still meeting their water needs. Add ideas for the classroom and school to make a connection with others. For example, students could do a water audit to determine how water is used in the school and then suggest ideas for reducing school water use. When the students have completed their entries, have each student carefully tape right water footprints slightly in front of their left footprint. (Wrap Up) Discuss why reducing water use is important—how does water use impact Earth?*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *Discuss cause and effect relationships between water use and impacts to Earth.* ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-2), (MS-ESS3-3)** • *Have students conduct research on corporate water footprints to determine how manufacturers are using, managing and protecting water. Why do corporations keep track of how water is used? How do they report water use? (Extension)* • *Have students research new technologies for reducing water use (low flow toilets, Energy star appliances, etc.).*

	• Have students conduct research on corporate water footprints to determine how manufacturers are using, managing and protecting water. Why do corporations keep track of how water is used? How do they report water use? (Extension) *• Students may want to investigate ways they can reduce their water consumption. They can compare water use before and after implementing water conservation practices. (Extension)*	

NGSS Common Core Connections:
ELA/Literacy -
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS3-3)
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1),(MS-ESS3-4)

Mathematics -
MP.2 Reason abstractly and quantitatively. (MS-ESS3-2),(MS-ESS3-5)

Connections to other Common Core Standards at this Grade Level: *ELA*: RST.6-8.8; W.3-5.8 ***Math*:** 3.MD.3; 6.NS.3

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions • to clarify and/or refine a model, an explanation, or an engineering problem. • that require sufficient and appropriate empirical evidence to answer. • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
Planning and carrying out investigatio ns	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Analyze and interpret data to provide evidence for phenomena. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.

Additional Crosscutting Concepts by Grade Level 6-8	
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Correlation Comments	**Correlator Initials:** MJW
Possible Alignments *K-ESS3-3—if simplified, this could fit here content wise* *This activity supports the following PEs* *5-ESS3-1*—content (DCI) fits* *MS-ESS3-3*—needs to incorporate more info on the big picture of water use and impact to the planet—WHY conserve water?*	

Project WET: Nature Rules!

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Topic:	Project WET Guide, Page #: Guide 2.0, p. 277
Brief Lesson Description: Students research the history of specific water-related natural disasters and write newspaper stories about the area's past, present and future.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA
NGSS Common Core Connections: ***ELA/Literacy – NA*** ***Mathematics – NA*** **Connections to other Common Core Standards at this Grade Level:** SL.6-8.4, SL.6-8.5, W.6-8.5, WHST.6-8.4, WHST.6-8.9		

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Correlation Comments	**Correlator Initials:** ELC
This activity has no links to any NGSS as written. It is an ELA activity and has students write a newspaper story about a natural disaster. Emphasis is on writing journalistic pieces, using both facts and creative writing to produce a good story. There is a link to MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. The background information does lead to this idea and the final Extension idea does too. The final Extension that has students determine sites that might be vulnerable to disaster and what could be "done to avert disaster or to lessen the effects". There is no technology link and perhaps this activity doesn't need one. I didn't feel that I could link this NGSS here, since it only appears as a partial correlation to one of the Extensions…but I did go through the SEP and CCC charts to find links that might also go along with the Extension and the research they will do on their natural disasters.	

Project WET: Nature Rules!

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: HS	**Topic:**	**Project WET Guide, Page #:** Guide 2.0, p. 277
Brief Lesson Description: Students research the history of specific water-related natural disasters and write newspaper stories about the area's past, present and future.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA
NGSS Common Core Connections: ***ELA/Literacy – NA*** ***Mathematics – NA*** **Connections to other Common Core Standards at this Grade Level:** SL.9-12.4, SL.9-12.5, W.9-12.5, WHST.9-12.4, WHST.9-12.9		

Additional SEP Connections: Grades 9-12	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.

Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Correlation Comments	**Correlator Initials:** ELC

This activity has no links to any NGSS as written. It is an ELA activity and has students write a newspaper story about a natural disaster. Emphasis is on writing journalistic pieces, using both facts and creative writing to produce a good story.

There is a link to HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. The background information does lead to this idea (or, the opposite of this where people used to not build in flood plains, for example) and the final Extension idea does too. The final Extension that has students determine sites that might be vulnerable to disaster and what could be "done to avert disaster or to lessen the effects".

I didn't feel that I could link this NGSS here, since it only appears as a partial correlation to one of the Extensions…but I did go through the SEP and CCC charts to find links that might also go along with the Extension and the research they will do on their natural disasters.

Project WET: Ocean Habitats

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
**Blue text demonstrates the Extension section of the activity.*

Grade: 3	Biological Evolution: Unity and Diversity	Project WET Guide, Page #: Guide 2.0, p. 73
Brief Lesson Description: Students learn about mysterious marine creatures and the zones they occupy beneath the surface of the ocean.		
Performance Expectation:		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy – NA*** ***Mathematics – NA*** ***Connections to other Common Core Standards at this Grade Level:* ELA:** L.3-5.6, RI.3-5.1, RI.3.7, RI.4.7, W.3-5.9 **MATH**: 4.NBT.2		

Additional SEP Connections: Grades 3-5	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop and/or use models to describe and/or predict phenomena.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.

Correlation Comments	**Correlator Initials:** ELC

Ocean Habitats is intended to teach students about different depths of the ocean and the organisms that inhabit those regions of the ocean. It is very informative, but really doesn't get to the level of any of the NGSS PEs completely. As with many activities that don't match, it could *lead* to a few NGSS PEs, but would have to have some additions that were definite in nature. A couple of spots in the activity text suggest one might do something, but don't ask students to actually do it, so wording would have to be stronger to really get at some of these PEs.

The second bullet in the Wrap Up section could lead to the following PE:

3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well and some cannot survive at all.

Honestly, many 3rd graders may need help in reading the cards, so I'm not sure about the appropriateness of this activity for that grade. In addition, I'm pretty sure that this reference to "habitat" is thinking land vs. water, etc. and NOT zones in the ocean, but assuming that this activity is appropriate for 3rd grade, here are some suggestions: Students could be asked if they thought the swordfish could survive at the deepest depths and why. Or, perhaps they can be asked to find one animal from the sunlit (top) zone that might be able to survive at the next level down and why (their evidence).

This bullet was focused mostly on adaptations, which could also be used for evidence.

Additionally, the first and third Extension ask students to research different submersibles and possibly design their own, but the wording would need to be stronger to actually fit with the following Engineering NGSS PEs:

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Students would need to do more than simply research. Even designing and constructing, as mentioned in the 3rd Extension doesn't quite get to the level of these Engineering PEs.

I'm actually thinking that this activity might work as an enrichment-type activity for 5th graders, but isn't really appropriate for 3rd or 4th…would like to know what elementary teachers/experts think on this. And, since it doesn't match up with any NGSS PEs for 5th, then evaluating it's usefulness in helping students with SEPs and CCCs comes next. It is also aimed at MS and HS and I do think it is better for those ages, especially MS.

Project WET: Ocean Habitats

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	**Ecosystems: Interactions, Energy, and Dynamics/ Engineering Design**	**Project WET Guide, Page #: Guide 2.0, p. 73**
Brief Lesson Description: Students learn about mysterious marine creatures and the zones they occupy beneath the surface of the ocean.		
Performance Expectation: MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. *[Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]*		
Performance Expectation: MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
Performance Expectation: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Performance Expectation: MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. **(MS-LS2-1)** Analyze and interpret data to determine similarities and differences in findings. **(MS-ETS1-3)** • *Student teams analyze activity cards for clues to identify life form adaptations and the life zone(s) each occupies. (Wrap-up)* • *Students identify additional organisms described in clue cards and add to their ocean layers diagram.* • *Student teams present an overview of the creatures they encountered during their Race to the Bottom. (Wrap-up)* • *Student teams use evidence from the pooled activity card data to identify key environmental factors that affect the growth of life forms in each ocean life zone.* • *Students use grade appropriate math to compare key environmental factors that affect the growth of life forms in each ocean life zone.* • *Students gather additional data on ocean life zones and marine species through a variety of sources. (Extensions)* • *Student teams use evidence from the pooled activity card data to identify food niches and develop a food web for each ocean life zone.*	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. **(MS-LS2-1)** In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. **(MS-LS2-1)** Growth of organisms and population increases are limited by access to resources. **(MS-LS2-1)** • *Student teams develop a diagram demonstrating what they may know of each ocean life zone from the shallowest to the deepest.* • *Student teams brainstorm potential environmental changes and hazards lifeforms may need to overcome to live in each ocean life zone.* • *Students develop questions they have about each life zone and life under the sea.* • *Student teams engage in a simulation game to discover lifeforms living in undersea life zones.(Activity)* • *Student teams analyze activity cards for clues to identify life form adaptations and the life zone(s) each occupies. (Wrap-up)* • *Students identify additional organisms*	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-LS2-1)** • *Student teams brainstorm potential environmental changes and hazards lifeforms may need to overcome to live in each ocean life zone.* • *Student teams analyze activity cards for clues to identify life form adaptations and the life zone(s) each occupies. (Wrap-up)* • *Student teams use evidence from the pooled activity card data to identify key environmental factors that affect the growth of life forms in each ocean life zone.* • *Students use grade appropriate math to compare key environmental factors that affect the growth of life forms in each ocean life zone.* • *Student teams use evidence from the pooled data to identify food niches and develop a food web for each ocean life zone.* • *Student teams use evidence from the pooled activity card data to develop a chart of key environmental factors defining and correlating organism adaptations in each ocean life zone .* • *Students investigate threats to ocean life zones and identify threat sources in their community.* • *Students participate in or host a water*

- *Student teams use evidence from the pooled activity card data to develop a chart of key environmental factors defining and correlating organism adaptations in each ocean life zone .*
- *Students investigate threats to ocean life zones and identify threat sources in their community.*
- *Students quantify the results of their community action event and use the data to educate the school and community about the connection between local water and oceans.*
- *Students research the submersible represented on their game piece and develop a description of engineering features unique to their choice of submersible. (Extension)*
- *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs. unmanned, ROVs vs. AUVs, etc.*
- *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.*
- *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.*
- *Students use their criterion charts design their own submersible in a drawing or computer design program. (Extension)*

Asking Questions and Defining Problems
Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **(MS-ETS1-1)**

- *Student teams brainstorm potential environmental changes and hazards lifeforms may need to overcome to live in each ocean life zone.*
- *Students develop questions they have about each life zone and life under the sea.*
- *Student teams use evidence from the pooled activity card data to identify key environmental factors that affect the growth of life forms in each ocean life zone.*
- *Students use grade appropriate math to compare key environmental factors that affect the growth of life forms in each ocean life zone.*
- *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs. unmanned, ROVs vs. AUVs, etc.*
- *Students develop a criterion chart to compare engineering features of a variety described in clue cards and add to their ocean layers diagram.*
- *Student teams present an overview of the creatures they encountered during their Race to the Bottom. (Wrap-up)*
- *Student teams use evidence from the pooled activity card data to identify key environmental factors that affect the growth of life forms in each ocean life zone.*
- *Students use grade appropriate math to compare key environmental factors that affect the growth of life forms in each ocean life zone.*
- *Students gather additional data on ocean life zones and marine species through a variety of sources. (Extensions)*
- *Student teams use evidence from the pooled data to identify food niches and develop a food web for each ocean life zone.*
- *Student teams use evidence from the pooled activity card data to develop a chart of key environmental factors defining and correlating organism adaptations in each ocean life zone .*
- *Students investigate threats to ocean life zones and identify threat sources in their community.*
- *Students participate in or host a water cleanup or other ocean threat mitigation action event to mitigate local threat sources to ocean life.*
- *Students quantify the results of their community action event and use the data to educate the school and community about the connection between local water and oceans.*

ETS1.A: Defining and Delimiting Engineering Problems
The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. **(MS-ETS1-1)**

- *Students use grade appropriate math to compare key environmental factors that affect the growth of life forms in each ocean life zone.*
- *Students research the submersible represented on their game piece and develop a description of engineering features unique to their choice of submersible. (Extension)*
- *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs. unmanned, ROVs vs. AUVs, etc.*
- *Students compare engineering features of each game piece submersible and develop a list of criteria for developing a craft that can function at the bottom of the sea.*
- *Students use grade appropriate math to compare key environmental factors that affect the growth of life forms in each ocean life zone.*
- *Students participate in or host a water cleanup or other ocean threat mitigation action event to mitigate local threat sources to ocean life.*
- *Students quantify the results of their community action event and use the data to educate the school and community about the connection between local water and oceans.*

Connections to Nature of Science

Influence of Engineering, Technology, and Science on Society and the Natural World
All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ETS1-1)**

- *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs. unmanned, ROVs vs. AUVs, etc.*
- *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.*
- *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.*
- *Students are challenged to design a vessel integrating bio-mimicry to explore in one of the ocean life zones.*
- *Students determine and justify type of vehicle to use – i.e., manned submersible, unmanned ROV, unmanned AUV.*

The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. **(MS-ETS1-1)**

- *Student teams use evidence from the pooled activity card data to develop a chart of key environmental factors defining and correlating organism adaptations in each ocean life zone .*
- *Students research the submersible represented on their game piece and develop a description of engineering features unique to their choice of submersible. (Extension)*
- *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs. unmanned, ROVs vs. AUVs, etc.*
- *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.*
- *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.*

of underwater exploration vessels. • *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.* • *Students use the criteria to design their own submersible in a drawing or computer design program. (Extension)* **Engaging in Argument from Evidence** Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-ETS1-2)** • *Student teams use evidence from the pooled activity card data to develop a chart of key environmental factors defining and correlating organism adaptations in each ocean life zone .* • *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs. unmanned, ROVs vs. AUVs, etc.* • *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.* • *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.* • *Students determine and justify type of vehicle to use – i.e., manned submersible, unmanned ROV, unmanned AUV.* • *Students build and test underwater remotely-operated vehicles (ROVs) through SeaPerch or other school robotics design programs. (Extension)*	• *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.* • *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.* • *Students use the criteria to design their own submersible in a drawing or computer design program. (Extension)* • *Students use the criteria to design their own submersible in a drawing or computer design program. (Extension)* • *Students build and test underwater remotely-operated vehicles (ROVs) through SeaPerch or other school robotics design programs. (Extension)* **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2), (MS-ETS1-3)** Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. **(MS-ETS1-3)** • *Students compare engineering features of each game piece submersible and develop a list of criteria for developing a craft that can function at the bottom of the sea.* • *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.* • *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.* • *Students are challenged to design a vessel integrating bio-mimicry to explore in one of the ocean life zones.* • *Students use the criteria to design their own submersible in a drawing or computer design program. (Extension)* **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. **(MS-ETS1-3)** • *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs. unmanned, ROVs vs. AUVs, etc.* • *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.* • *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.* • *Students design a vessel integrating bio-*	• *Students are challenged to design a vessel integrating bio-mimicry to explore in one of the ocean life zones.* • *Students determine and justify type of vehicle to use – i.e., manned submersible, unmanned ROV, unmanned AUV.*

	mimicry to explore in one of the ocean life zones. • *Students determine and justify type of vehicle to use – i.e., manned submersible, unmanned ROV, unmanned AUV.* • *Students use the criteria to design their own submersible in a drawing or computer design program. (Extension)* • *Students determine and justify type of vehicle to use – i.e., manned submersible, unmanned ROV, unmanned AUV.* • *Students build and test underwater remotely-operated vehicles (ROVs) through SeaPerch or other school robotics design programs. (Extension)*	

NGSS Common Core Connections:

ELA/Literacy –

RST.6–8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
RST.6–8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1),((MS-ETS1-3)
RST.6–8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS2-1),((MS-ETS1-3)
WHST.6–8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-1),(MS-ETS1-1)
WHST.6–8.8	Gather relevant information from multiple print and digital sources (primary and secondary), using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1)
WHST.6–8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
6.EE.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1),(MS-LS1-2),(MS-LS1-3)

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Evaluate the accuracy of various methods for collecting data. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. • Collect data about the performance of a proposed object, tool, process or system under a range of conditions.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Energy and Matter	Energy and Matter: Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.

Structure and Function	Structure and Function: Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

The general *intent* of 'Ocean Habitats' correlates to the MS Grade NGSS Performance Expectation MS-LS2-1, but the components of the activity do not correlate *as written*. As noted in the clarification statement for MS-LS2-1 the *'emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.'* The activity as written dances around the *'cause and effect relationships between resources and growth of individual organisms'* by having students study the connections between the environmental conditions in each ocean life zone and evidence from the clue cards on how this influences the lifeforms found in each zone – the abundancy or scarcity of resources in this case is a primarily a function of environmental parameters, though I've added suggestions for having students investigate the connections to human actions that can alter ocean life zones.

The modifications in gray and suggested re-alignment below would strengthen activity correlation the activity to the PE MS-LS2-1 elements ***and*** allows for correlation to the additional Engineering Design PEs: MS-ETSI-1, MS-ETS1-2 and MS-ETS1-3 and most of the connecting CCSS.

Even with these changes, the activity *does not* correlate to the second half of the PE clarification element regarding '*the numbers of organisms in ecosystems.*' I have included potential links to draw this population data from at the bottom of these notes, but found plenty of *description*, but very few *numbers* that students – or anyone else - could analyze and compare. The reality is population data is still very tough to get with any degree of statistical accuracy for most organisms in the ocean for the very same reasons it is difficult for us to explore the area – this conclusion is addressing the second part of the PE with a real-life answer – we still don't have the ability to count every living creature on the planet – but not sure this would be vied as acceptable by the hardcore detail NGSS folks out there….

Below is the suggested modification outline:

Warm-up: What Lies in the Depths?

- *Students review & discuss historical evidence from maps, textbooks or online resources of human perceptions of life in the deep sea.*
- *Student teams develop a diagram demonstrating what they may know of each ocean life zone from the shallowest to the deepest.*
- *Student teams brainstorm potential environmental changes and hazards lifeforms may need to overcome to live in each ocean life zone.*
- *Students develop questions they have about each life zone and life under the sea.*

Part I: 20,000 Leagues Under the Sea (First exploration)

- *Student teams engage in a simulation game to discover lifeforms living in undersea life zones.(Activity)*
- *Student teams analyze activity cards for clues to identify life form adaptations and the life zone(s) each occupies. (Wrap-up)*
- *Students identify additional organisms described in clue cards and add to their ocean layers diagram.*
- *Student teams present an overview of the creatures they encountered during their Race to the Bottom. (Wrap-up)*
- *Student teams use evidence from the pooled activity card data to identify key environmental factors that affect the growth of life forms in each ocean life zone.*

Part ll: The Undersea World of Jacques Cousteau (Defining ocean life zones)

- *Students use grade appropriate math to compare key environmental factors that affect the growth of life forms in each ocean life zone.*
- *Students gather additional data on ocean life zones and marine species through a variety of sources, including sites such as: www.youtube.com/oceanexplorer.gov or Google Earth with the ocean layer activated (Extensions)*
- *Student teams use evidence from the pooled data to identify food niches and develop a food web for each ocean life zone.*
- *Student teams use evidence from the pooled activity card data to develop a chart of key environmental factors defining and correlating organism adaptations in each ocean life zone .*

ActionEducation ™

- *Students investigate threats to ocean life zones and identify threat sources in their community.*
- *Students participate in or host a water cleanup or other ocean threat mitigation action event to mitigate local threat sources to ocean life.*
- *Students quantify the results of their community action event and use the data to educate the school and community about the connection between local water and oceans.*

Part Ill: Voyage to the Bottom of the Sea (Engineering a Better Deepsea Vessel)

- *Students research the submersible represented on their game piece and develop a description of engineering features unique to their choice of submersible. (Extension)*
- *Students analyze different vessels for underwater exploration while determining benefits, trade-offs, constraints – i.e., Manned vs.*

unmanned, ROVs vs. AUVs, etc.

- *Students develop a criterion chart to compare engineering features of a variety of underwater exploration vessels.*
- *Students develop a criterion chart to compare ocean life zone adaptations to environmental factors and engineering features required to explore each ocean life zone.*
- *Students are challenged to design a vessel integrating bio-mimicry to explore in one of the ocean life zones.*
- *Students use the criteria to design their own submersible in a drawing or computer design program. (Extension)*
- *Students determine and justify type of vehicle to use – i.e., manned submersible, unmanned ROV, unmanned AUV.*

ActionEducation ™

- *Students build and test underwater remotely-operated vehicles (ROVs) through MATE, SeaPerch or other school robotics design programs. (Extension)*

Resources:
ARTICLE: 'The Enchanting Sea Monsters on Medieval Maps' http://www.smithsonianmag.com/science-nature/the-enchanting-sea-monsters-on-medieval-maps-1805646/
Ocean Life and Parameters:
Marine Bio: http://marinebio.org/oceans/marine-zones; http://marinebio.org/oceans/open-ocean/ http://marinebio.org/oceans/deep
Ocean Portal: https://ocean.si.edu/census-marine-life
Woods Hole Oceanographic Institution: http://www.whoi.edu
Census of Marine Life: http://www.coml.org/census-framework
ArcOD - Arctic Ocean Diversity
CAML - Census of Antarctic Marine Life
CeDAMar - Census of the Diversity of Abyssal Marine Life
ChEss - Biogeography of Deep-Water Chemosynthetic Ecosystems
MAR-ECO - Mid-Atlantic Ridge Ecosystem Project
FMAP - Future of Marine Animal Populations
Which Ocean Has the Most Marine Life? http://marinesciencetoday.com/2014/05/05/which-ocean-has-the-most-marine-life/

Engineering
NOAA: Submersible Technology: http://oceanexplorer.noaa.gov/technology/subs/subs.html
Japan Agency for Marine-Earth Science and Technology: http://www.jamstec.go.jp/e/about/equipment/ships
Ifremer Fleet: Nautile: http://flotte.ifremer.fr/fleet/Presentation-of-the-fleet/Underwater-systems/Nautile
Submarines & Deep Technology: http://marinebio.org/oceans/submarines
Jason Learning: http://www.immersionlearning.org (*Under Games students can use My ROV game to design an ROV*)
Challenger Deep: http://nationalgeographic.org/education/deepsea-challenge/?ar_a=1
Design Features of Challenger Deep: http://www.deepseachallenge.com/the-sub/sub-facts
Nereus: https://www.whoi.edu/main/nereus (*Understand the difficulties of working in deep water*)
Bio-mimicry:
http://webecoist.momtastic.com/2011/01/14/brilliant-bio-design-14-animal-inspired-inventions
http://spectrum.ieee.org/video/robotics/robotics-hardware/octopusinspired-robots-can-grasp-crawl-and-swim
Article: 'Realizing the Dreams of da Vinci and Verne': https://www.whoi.edu/page.do?pid=10076&tid=3622&cid=2462

ActionEducation Elements:
Carbon Calculators:
http://meetthegreens.pbskids.org/features/carbon-calculator.html
https://www3.epa.gov/climatechange/kids/calc/
SeaPerch Program- http://www.seaperch.org/index
MATE (Marine Advanced Technology Education) - http://www.marinetech.org

Project WET: On Track with Hydration

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 3	Heredity: Inheritance and Variation of Traits	Project WET Guide, Page #: Guide 2.0, p. 95
Brief Lesson Description: Water is critical for keeping our bodies hydrated. By staying on track with hydration (making healthy food and beverage choices and measuring our intake) we can help achieve optimum physical and mental performance.		
Performance Expectation: 3-LS3-2: Use evidence to support the explanation that traits can be influenced by the environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems **(3-LS3-2).** • *Use evidence (e.g., observations, patterns) to support an explanation* • *Students are asked to think about the water they drink and their activity level. (Warm Up)* • *Students play a game in which they enter or leave the body, as fluids. (Warm Up)* • *Students add or subtract water from a cup as they consider when water enters and leaves the body. (Part I)* • *Students play a board game, adding and subtracting liquids and also counting calories of the liquids we may drink. (Part II)* • *Students consider making a change to stay hydrated with nutritious choices and track their progress for a week. (Part III)*	**LS3.A: Inheritance of Traits** Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment **(3-LS3-2).** **LS3.B: Variation of Traits** The environment also affects the traits that an organism develops. • *Students play a board game, adding and subtracting liquids and also counting calories of the liquids we may drink. (Part II)* • *Students consider making a change to stay hydrated with nutritious choices and track their progress for a week. (Part III)* • *Students can organize a health fair and involve health professionals. (ActionEducation)* • *Students can research how habits are changed and how long it may take. (Extension)*	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. **(3-LS3-2).** • *Students are asked to think about the water they drink and their activity level. (Warm Up)* • *Students play a game in which they enter or leave the body, as fluids. (Warm Up)* • *Students add or subtract water from a cup as they consider when water enters and leaves the body. (Part I)* • *Students play a board game, adding and subtracting liquids and also counting calories of the liquids we may drink. (Part II)* • *Students consider making a change to stay hydrated with nutritious choices and track their progress for a week. (Part III)* • *Students are asked what might happen if water input didn't equal water output. (Wrap Up)*

NGSS Common Core Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1),(3-LS3-2)

RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3-LS3-1),(3-LS3-2)*

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1*),(3-LS3-2)*

W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS3-1),*(3-LS3-2)

SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. *(3-LS3-1), (3-LS3-2)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(3-LS3-1),(3-LS3-2)*

MP.4 Model with mathematics. *(3-LS3-1),(3-LS3-2)*

3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a

line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. *(3-LS3-1),(3-LS3-2)* **Connections to other Common Core Standards at this Grade Level:** SL.3.1c, 3.MD.2, 3.MD.4, 3.NF.2a, 3.NF.2b

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developin g and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop and/or use models to describe and/or predict phenomena.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

Correlation Comments	**Correlator Initials:** ELC
On Track with Hydration, Part II, in which students start thinking about calories, could lead to the following NGSS PE: **5-PS3-1:** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. It would take some work to make the link to the sun, but could be done. This would also be a good way to tie in that humans are also animals.	

Project WET: On Track with Hydration

* Activities are correlated <u>as written.</u> However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: HS		**Project WET Guide, Page #:** Guide 2.0, p. 95
Brief Lesson Description: Water is critical for keeping our bodies hydrated. By staying on track with hydration (making healthy food and beverage choices and measuring our intake) we can help achieve optimum physical and mental performance.		
Performance Expectation: NA		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy –*** ***Mathematics –*** **Connections to other Common Core Standards at this Grade Level**: SL.9-12.1c		

Additional SEP Connections: Grades 9-12	
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. •Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Systems and System Models	Systems and System Models: Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Correlation Comments	**Correlator Initials:** ELC

On Track with Hydration, Part II only, in which students start thinking about calories, *could* lead to the following NGSS PE:

HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

This NGSS PE is much more complex than the activity, but Part II of *On Track with Hydration* could serve as an activity to begin students thinking about this and would be a way to start with something they know before moving on to chemical reactions and what is truly happening in the body. The link here is a bit of a stretch and I don't propose including this NGSS PE into the activity, but a note to teachers about the possible connection might be helpful.

In addition, this activity does NOT get to the level of most of the SEPs (and possibly CCCs) for the HS level, even though it did for both upper elementary and middle school.

As a teacher, I might use this activity as an introduction for the above NGSS PE, but honestly, probably wouldn't spend the time on it, given the complexity of the PE. Perhaps it could be used for certain classes, aimed at ninth grade, but at the HS level, this is likely best for a health class.

Post Review Comments: I agree with Erica, this activity is better aligned with Health Standards at this level—the HS science is more in depth than this activity gets. I think adding an extension to address an entire PE (as one reviewer suggests) is not a good idea in this case (too much of a stretch from what the content currently is), but could be potential for a second activity later.

Project WET: Pass the Jug

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: K	**Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 447
Brief Lesson Description: Students simulate and analyze different water rights policies to learn how water availability and people's proximity to the resource influence how water is allocated.		
Performance Expectation: K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. Use a model to represent relationships in the natural world. **(K-ESS3-1)** • *Ask students how they would divide a bag of candy among the class. Would everyone get the same number of pieces? How would they decide? (K-2 Warm Up)* • *During snack time, provide the class with a jug of water. Begin filling students' cups, or hand the jug to students and have them fill their own cups. Tell them not to drink until each student has water in his or her cup. (Activity, Step 1)* • *When you run out of water, assess the reactions of students who did and did not receive something to drink. (Activity, Step 2)* • *Tell them that this is all the available water. Ask for suggestions about how to make sure that everyone gets water. Help them to consider the idea of evenly distributing the water among the students. (Activity, Step 3)*	**ESS3.A: Natural Resources** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. **(K-ESS3-1)** • *Ask students how they would divide a bag of candy among the class. Would everyone get the same number of pieces? How would they decide? (K-2 Warm Up)* • *During snack time, provide the class with a jug of water. Begin filling students' cups, or hand the jug to students and have them fill their own cups. Tell them not to drink until each student has water in his or her cup. (Activity, Step 1)* • *When you run out of water, assess the reactions of students who did and did not receive something to drink. (Activity, Step 2)* • *Tell them that this is all the available water. Ask for suggestions about how to make sure that everyone gets water. Help them to consider the idea of evenly distributing the water among the students. (Activity, Step 3)* • *Have students summarize the importance of sharing water and other resources. (Wrap Up)*	**Systems and System Models** Systems in the natural and designed world have parts that work together. **(K-ESS3-1)** • *Have students summarize the importance of sharing water and other resources. (Wrap Up)*
NGSS Common Core Connections: ***ELA/Literacy -*** **SL.K.3** Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2) ***Mathematics -*** **MP.2** Reason abstractly and quantitatively. (K-ESS3-1) **K.CC** Counting and Cardinality (K-ESS3-1),(K-ESS3-2) **Connections to other Common Core Standards at this Grade Level:** ***ELA***: RI.6-8.4; RST.6-8.3; RST.6-8.4; RST.6-8.9; SL.2.2; SL.6-8.1c; W.5.8; W.6-8.7; WHST.6-8.7 ***Math***: 3.OA.2		

Additional SEP Connections:

Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Correlation Comments	**Correlator Initials:** MJW
Possible alignments *K-ESS3-1*--Alignment works here, but Prior Appropriation Doctrine is a big concept for Kindergartners!* *MS-LS2-1—In theory this activity focuses on the content addressed by this PE, however, since the main focus of the activity is water availability based on human constructed laws, not geographical availability and competition for resources, it is not actually a good fit.* *MS-ESS3-1 and MS-ESS3-4—both of these PEs seem close, but since the focus of the activity is availability and use of water dictated based on human constructed laws, not geographical availability and competition for resources, it is not actually a good fit.* *HS-ESS3-1—Close in content, this PE is more focused on how geographical distribution of resources has guided human society—not on how humans have chosen to regulate those resources in certain areas. These ideas are tied together, though and this activity would be a good government/social studies activity to explore when students are learning about this science concept.*	

Project WET: Poison Pump

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Earth and Human Activity/ Ecosystems: Interactions, Energy, and Dynamics	Project WET Guide, Page #: Guide 2.0, p. 107
Brief Lesson Description: Through a series of clues, students solve a mystery to discover that water can also produce negative effects for people.		
Performance Expectation: MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.		
Performance Expectation: MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.		
Performance Expectation: MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. **(MS-LS2-1)** • *Students read descriptions of the 1854 Cholera outbreak and record information that may be used to investigate the outbreak.* • *Students discuss investigative methods used to solve crimes that can be applied to tracing disease. (Warm – up)* • *Students apply investigative methods used by epidemiologists to trace the source of a waterborne disease (steps 4-6).* • *Students develop an argument from evidence on the source of the 1854 London Cholera outbreak.* • *Students research where cholera is active in the world today and the relationship to water scarcity. (Extensions)* • *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)* **Engaging in Argument from Evidence** Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-ESS3-4), (MS-LS2-4)** • *Students develop an argument from evidence on the source of the 1854 London Cholera outbreak.* • *Students discuss why most people who live in the United States and Canada need not worry about becoming infected with*	**ESS3.C: Human Impacts on Earth Systems** Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-4)** • *Students read descriptions of the 1854 Cholera outbreak and record information that may be used to investigate the outbreak.* • *Students research diseases that directly result from water scarcity (Extensions)* • *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)* **LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. **(MS-LS2-1)** ***Supplemental DCI PS1.B*** Growth of organisms and population increases are limited by access to resources. **(MS-LS2-1)** • *Students read descriptions of the 1854 Cholera outbreak and record information that may be used to investigate the outbreak.* • *Students develop an argument from evidence on the source of the 1854 London Cholera outbreak.* • *Students investigate how water from the pump became contaminated. (Wrap-Up)* • *Students research what is know about cholera today and how pathogens are prevented from entering their water supplies. (Wrap Up)* • *Students discuss why most people who live in the United States and Canada need not worry about becoming infected with cholera.*	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-ESS3-4), (MS-LS2-1)** • *Students apply investigative methods used by epidemiologists to trace the source of a waterborne disease (steps 4-6).* • *Students develop an argument from evidence on the source of the 1854 London Cholera outbreak.* • *Students investigate how water from the pump became contaminated. (Wrap Up)* • *Students research what is know about cholera today and how pathogens are prevented from entering their water supplies. (Wrap-Up)* • *Students investigate how their community water suppliers and health department officials would manage a waterborne disease outbreak. (Extension)* • *Students research where cholera is active in the world today and the relationship to water scarcity. (Extensions)* • *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)* • *Students make a poster of waterborne diseases that have occurred in their community and how people can avoid contracting them. (Wrap-up)* **Stability and Change** Small changes in one part of a system might cause large changes in another part. **(MS-LS2-4)** • *Students read descriptions of the 1854 Cholera outbreak and record information*

cholera. (Wrap-up)

- *Students make a poster of waterborne diseases that have occurred in their community and how people can avoid contracting them. (Wrap-up)*

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Science disciplines share common rules of obtaining and evaluating empirical evidence. **(MS-LS2-4)**

- *Students read descriptions of the 1854 Cholera outbreak and record information that may be used to investigate the outbreak.*
- *Students discuss investigative methods used to solve crimes that can be applied to tracing disease. (Warm – up)*
- *Students apply investigative methods used by epidemiologists to trace the source of a waterborne disease (steps 4-6).*

(Wrap-up)

- *Students research where cholera is active in the world today and the relationship to water scarcity. (Extensions)*
- *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)*
- *Students make a poster of waterborne diseases that have occurred in their community and how people can avoid contracting them. (Wrap-up)*

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. **(MS-LS2-4)**

- *Students read descriptions of the 1854 Cholera outbreak and record information that may be used to investigate the outbreak.*
- *Students develop an argument from evidence on the source of the 1854 London Cholera outbreak.*
- *Students investigate how water from the pump became contaminated. (Wrap Up)*
- *Students research where cholera is active in the world today and the relationship to water scarcity. (Extensions)*
- *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)*

that may be used to investigate the outbreak.

- *Students investigate how water from the pump became contaminated. (Wrap Up)*
- *Students research how pathogens are prevented from entering their water supplies. (Wrap Up)*
- *Students discuss why most people who live in the United States and Canada need not worry about becoming infected with cholera. (Wrap-up)*

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ESS3-4)**

- *Students read descriptions of the 1854 Cholera outbreak and record information that may be used to investigate the outbreak.*
- *Students investigate how water from the pump became contaminated. (Wrap Up)*
- *Students research what is know about cholera today and how pathogens are prevented from entering their water supplies. (Wrap Up)*
- *Students investigate how their community water suppliers and health department officials would manage a waterborne disease outbreak. (Extension)*
- *Students discuss why most people who live in the United States and Canada need not worry about becoming infected with cholera. (Wrap-up)*
- *Students research where cholera is active in the world today and the relationship to water scarcity. (Extensions)*
- *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)*

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. **(MS-ESS3-4)**

- *Students develop an argument from evidence on the source of the 1854 London Cholera outbreak.*
- *Students investigate how water from the pump became contaminated. (Wrap Up)*
- *Students research where cholera is active in the world today and the relationship to water scarcity. (Extensions)*

		• *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)*

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-4),(MS-LS2-1), (MS-LS2-4)

WHST.6-8.1 Write arguments focused on discipline content. (MS-ESS3-4)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)

RI.8.8 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4)

WHST.6-8.1 Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-4),(MS-LS2-4)

Mathematics –

6.RP.A.1 ~~Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS3-4)*~~

7.RP.A.2 ~~Recognize and represent proportional relationships between quantities. *(MS-ESS3-4)*~~

6.EE.B.6 ~~Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS3-4)*~~

7.EE.B.4 ~~Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS3-4)*~~

Connections to other Common Core Standards at this Grade Level: RH.6-12.4; RH.6-8.7; RL.3-12.4

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB
The elements of Poison Pump correlates very well to MS grades NGSS Performance Expectations MS-ESS3-4, MS-LS2-1 and MS-LS2-4 *as written*, ***but only if*** the activity is revised to integrate the existing Extensions and the few modifications in grey are included to strengthen correlation alignments. I could find no easy way to include Math to align to the CCSS Math linked to this set of PEs, but have left them in the document above in strike through in case others have thoughts. Below is a suggested outline to realign the activity: **Warm-up –** • *Students read descriptions of the 1854 Cholera outbreak and record information that may be used to investigate the outbreak.* *Potential website for obtaining a synopsis for use with the activity:* *http://www.choleraandthethames.co.uk/cholera-in-london/cholera-in-westminster/* • *Students discuss investigative methods used to solve crimes that can be applied to tracing disease. (Warm – up)*	

Part I:

- *Students apply investigative methods used by epidemiologists to trace the source of a waterborne disease (steps 4-6).*
- *Students develop an argument from evidence on the source of the 1854 London Cholera outbreak.*
- *Students investigate how water from the pump became contaminated. (Wrap Up)*

Part II:

- *Students research what is know about cholera today and how pathogens are prevented from entering their water supplies.* *http://www.cdc.gov/cholera/general/index.html (Wrap Up)*
- *Students research where cholera is active in the world today and the relationship to water scarcity. (Extensions)* *http://www.cdc.gov/cholera/index.html*
- *Students investigate how their community water suppliers and health department officials would manage a cholera or other waterborne disease outbreak. (Extension)*

Wrap-up:

- *Students discuss why most people who live in the United States and Canada need not worry about becoming infected with cholera. (Wrap-up)*

ActionEducation:

- *Students research the history of waterborne diseases and epidemics in their community, region and/or state. (Extension)*
- *Students make a poster of waterborne diseases that have occurred in their community and how people can avoid contracting them. (Wrap-up)*

Extensions/Resources: http://www.theghostmap.com /

Project WET: Raining Cats and Dogs

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** Blue text represents the Extension section of the activity.*

Grade: 3	**Earth's Systems**	**Project WET Guide, Page #:** Guide 2.0, p. 521
Brief Lesson Description: Students analyze and interpret water sayings—through a card game, skits, pantomime and creative writing—to compare figures of speech across cultures and climate zones.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NGSS Common Core Connections: **Connections to other Common Core Standards at this Grade Level: ELA**: RH.6-12.4; RH.6-8.7; RL.3-12.4;		

Additional SEP Connections: Grade 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Use data to evaluate claims about cause and effect.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.

Additional Crosscutting Concepts by Grade Level	
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	**Correlator Initials:** MJW
Possible Alignments *3-ESS2-2**	

Project WET: Rainy-Day Hike

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** Blue text represents the Extension section of the activity.*

Grade: Kindergarten	**Interdependent Relationships in Ecosystems:** Animals, Plants, and Their Environment	**Project WET Guide, Page #:** Guide 1.0, Portal, K -2 Option
Brief Lesson Description: Students are introduced to urban watershed concepts and storm water issues through an investigation of school buildings and grounds.		
Performance Expectation: K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.		
Performance Expectation: K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Construct an argument with evidence to support a claim. **(K-ESS2-2)** • *Students list what in the water was from humans and what was from plants, animals or the Earth.* • *Students discuss how the materials got into the water and how they might affect plants and animals downstream.* • *Students discuss how to reduce the amount of litter or harmful materials in water on tor leaving the school-yard.* **Obtaining, Evaluating, and Communicating Information** Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. **(K-ESS3-3)** • *Students work in small groups to observe where water flows on the school grounds.* • *Students observe and record what is in the water including their boat.* • *Students draw pictures describing what their tiny boat encountered and where it flowed as it floated on the school grounds.* • *Students list what in the water was from humans and what was from plants, animals or the Earth.* • *Students discuss how the materials got into the water and how they might affect plants and animals downstream.* • *Students discuss how to reduce the amount of litter or harmful materials in water on tor leaving the school-yard.*	**ESS2.E: Biogeology** Plants and animals can change their environment. **(K-ESS2-2)** • *Students work in small groups to observe where water flows on the school grounds.* • *Students observe and record what is in the water including their boat.* • *Students draw pictures describing what their tiny boat encountered and where it flowed on the school grounds.* • *Students list what in the water was from humans and what was from plants, animals or the Earth.* • *Students discuss how the materials got into the water and how they might affect plants and animals downstream.* • *Students discuss how to reduce the amount of litter or harmful materials in water on tor leaving the school-yard.* **ESS3.C: Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. **(secondary to K-ESS2-2), (K-ESS3-3)** • *Students observe and record what is in the water including their boat.* • *Students list what in the water was from humans and what was from plants, animals or the Earth.* • *Students discuss how the materials got into the water and how they might affect plants and animals downstream.* • *Students discuss how to reduce the amount of litter or harmful materials in water on tor leaving the school-yard.* **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches,	**Cause and Effect** Events have causes that generate observable patterns. **(K-ESS3-3)** • *Students draw pictures describing what their tiny boat encountered and where it flowed as it floated on the school grounds.* • *Students list what in the water was from humans and what was from plants, animals or the Earth.* • *Students discuss how the materials got into the water and how they might affect plants and animals downstream.* **Systems and System Models** Systems in the natural and designed world have parts that work together. **(K-ESS2-2)** • *Students work in small groups to observe where water flows on the school grounds.* • *Students observe and record what is in the water including their boat.* • *Students list what in the water was from humans and what was from plants, animals or the Earth.* • *Students discuss how the materials got into the water and how they might affect plants and animals downstream.*

	drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **(secondary to K-ESS3-3)** • *Students draw pictures describing what their tiny boat encountered and where it flowed as it floated on the school grounds.* • *Students discuss how the materials got into the water and how they might affect plants and animals downstream.* • *Students discuss how to reduce the amount of litter or harmful materials in water on tor leaving the school-yard.*	

NGSS Common Core Connections:
ELA/Literacy –

RI.K.1 With prompting and support, ask and answer questions about key details in a text. (K-ESS2-2)

W.K.1 Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book. (K-ESS2-2)

W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS2-2), (K-ESS3-3)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Generate and/or compare multiple solutions to a problem

Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.

Correlation Comments	**Correlator Initials:** DBB

Please note the correlations are for the K-2 Option as written (1 paragraph) in the copy from Guide 1.0. I've added suggested changes in gray to strengthen the alignment, but do not feel comfortable adding more as I do not have as much experience with the Primary grades. I believe this activity can be fleshed out in more detail to align with additional K-2 PEs, SEPs and CCCs and highly suggest enlisting the P & P WET team's ECE group to do so.

Also suggest revising activity to differentiate instructions into parts that build upon each other as 'Color Me a Watershed' is written – i.e., Warm-up of Rainy-Day Hike might be observing the school-yard and predicting where water might flow and what it might carry with it in a storm, with the suggestion for Kindergarteners building boats and using them to follow the flow. (*See additional notes on correlation templates for 2nd, 4th and 5th Grades.*)

Warm-up – Predicting/Observing K

- *Students work in small groups to observe where water flows on the school grounds.*
- *Students observe and record what is in the water including their boat.*
- *Students draw pictures describing what their tiny boat encountered and where it flowed on the school grounds.*
- *Students list what in the water was from humans and what was from plants, animals or the Earth.*
- *Students discuss how the materials got into the water and how they might affect plants and animals downstream.*
- *Students discuss how to reduce the amount of litter or harmful materials in water on tor leaving the school-yard.*

Project WET: Rainy-Day Hike

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 2	**Earth's Systems: Processes that Shape the Earth**	**Project WET Guide, Page #:** Guide 2.0, p. 169
Brief Lesson Description: Students are introduced to urban watershed concepts and storm water issues through an investigation of school buildings and grounds.		
Performance Expectation: 2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.		
Performance Expectation: 2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*		
Performance Expectation: 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to represent patterns in the natural world. **(2-ESS2-2)** • *Students create a map of the school grounds using mapping skills (Part I, steps 3-4).* • *Students predict and/or observe water flow over the school grounds (Part II, step 4).* • *Students identify areas where water flow is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students compare mapped predictions to mapped observations and measurements.* **Constructing Explanations and Designing Solutions** Make observations from several sources to construct an evidence-based account for natural phenomena. **(2-ESS1-1)** Compare multiple solutions to a problem. **(2-ESS2-1)** • *Students study a map of their school grounds and identify features they recognize* • *Students predict and/or observe water flow over the school grounds (Part II, step 4).* • *Students compare mapped predictions to mapped observations and measurements.* • *Students identify areas where water flow is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students write summaries describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).* • *Students brainstorm and compare*	**ESS1.C: The History of Planet Earth** Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. **(2-ESS1-1)** • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students write a summary describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).* **ESS2.A: Earth Materials and Systems** Wind and water can change the shape of the land. **(2-ESS2-1)** • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students write a summary describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).* **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps show where things are located. One can map the shapes and kinds of land and water in any area. **(2-ESS2-2)** • *Students study a map of their school grounds and identify features they recognize* • *Students create a map of the school grounds predicting where water will flow in a storm. (Part I, steps 3-4).* • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students compare mapped predictions to mapped observations and measurements.* • *Students write a summary describing the*	**Patterns** Patterns in the natural world can be observed. **(2-ESS2-2)** • *Students study a map of their school grounds and identify features they recognize* • *Students predict and/or observe water flow over the school grounds (Part II, step 4).* • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students compare mapped predictions to mapped observations and measurements.* • *Students write a summary describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).* **Stability and Change** Things may change slowly or rapidly. **(2-ESS1-1), (2-ESS2-1)** • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students write a summary describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).* ***Connections to Engineering, Technology, and Applications of Science*** Developing and using technology has impacts on the natural world. **(2-ESS2-1)** • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students brainstorm and compare solutions to correct water flow issues they identified on the school grounds.*

solutions to correct water flow issues they identified on the school grounds.	*general pattern of surface water as it flows across the school grounds (Part III, step 3).*	.... ***Connections to Nature of Science*** Scientists study the natural and material world. **(2-ESS2-1)** • *Students study a map of their school grounds and identify features they recognize* • *Students create a map of the school grounds predicting where water will flow in a storm. (Part I, steps 3-4).* • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students write a summary describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).*

NGSS Common Core Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (2-ESS1-1)

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1),(2-ESS2-1)

RI.2.9 Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1)

W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS1-1)

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1)

SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
a. Give and follow three- and four-step oral directions. CA (2-ESS1-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (2-ESS2-1),(2-ESS2-2)

MP.4 Model with mathematics. (2-ESS1-1),(2-ESS2-1),(2-ESS2-2)

MP.5 Use appropriate tools strategically. (2-ESS2-1)

2.NBT.1-4 Understand place value. (2-ESS1-1)

2.NBT.3 Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.

Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Systems and System Models	Systems and System Models: Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.

Correlation Comments | **Correlator Initials:** DBB

Rainy-Day Hike correlates to 2nd grade NGSS Performance Expectations 2-ESS1-1, 2-ESS2-1 2-ESS2-2 *as written*, but alignment could be enhanced if modifications in grey in accordance with suggestions below are adopted to flesh out and better correlate activity to Math NGSS and CCSS are included in the future – i.e., measuring distances, pacing, including measurements on the maps to show relative distances of map elements, etc.

Suggest revising activity to differentiate instructions into parts that build upon each other as 'Color Me a Watershed is written – i.e., Warm-up of Rainy-Day Hike would have Kindergarteners observing water flow on the school grounds by building boats and using them to follow the flow, while also observing where the water flows and what it is carrying. For other grades using this activity, students would be observing the schoolyard and predicting where they think water will flow in a storm.

Part I: Mapping Water Flow could be aimed at 2nd grade and have students mapping the schoolyard using a coordinate system, including measuring the size and relative distances from a central reference point on the schoolyard and between key features on the map. Student teams would then create a digital template – a copy/scan of their map or using a mapping program, as determined by the teacher. Student teams would then draw in their predicted routes of water flow on their maps, including short summaries on why they think the water will flow in these locations based on what they observed on the schoolyard. Students would then revisit the schoolyard after a storm and use a print off of their map template to map the actual flow of water on the schoolyard, then compare their before and after maps and write a summary of how, what and why their maps are similar or different – and noting any potential problems – i.e., puddling, erosion, litter, etc. This would align the activity to correlate with the additional PEs, NGSS dimension elements and CCSS standards shaded in gray in the 2nd grade NGSS document. (*See additional notes on correlation templates for K, 4th and 5th Grades.*)

Warm-up – Predicting/Observing

- *Students study a map of their school grounds and identify features they recognize.*

Part I: Mapping Water Flow

- *Students create a map of the school grounds using mapping skills (Part I, steps 3-4).*

- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students predict water flow over the school grounds (Part II, step 4).*
- *Students compare mapped predictions to mapped observations and measurements.*
- *Students identify areas where water flow is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).*
- *Students write summaries describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).*
- *Students brainstorm and compare solutions to correct water flow issues they identified on the school grounds.*

Project WET: Rainy-Day Hike

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 4	Earth's Systems: Processes that Shape the Earth	Project WET Guide, Page #: Guide 2.0, p. 169
Brief Lesson Description: Students are introduced to urban watershed concepts and storm water issues through an investigation of school buildings and grounds.		
Performance Expectation: 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.		
Performance Expectation: 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.		

Science & Engineering Practice(s)

Planning and Carrying Out Investigations
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. **(4-ESS2-1)**

- *Students predict and analyze water flow over the school grounds (Part II, step 4).*
- *Students create a map of the school grounds using mapping and measuring skills (Part I, steps 3-4).*
- *Students discuss and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).*
- *Students identify and map potential point and nonpoint source contaminants. (Part II, step 3).*
- *Students use a digital mapping program to trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)*

Analyzing and Interpreting Data
Analyze and interpret data to make sense of phenomena using logical reasoning. **(4-ESS2-2)**

- *Students predict and/or observe water flow over the school grounds (Part II, step 4).*
- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students compare mapped predictions to mapped observations and measurements.*
- *Students identify areas where the flow of water is slowed by landforms and*

Disciplinary Core Idea(s)

ESS2.A: Earth Materials and Systems
Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. **(4-ESS2-1)**

- *Students predict and/or observe water flow over the school grounds (Part II, step 4).*
- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).*
- *Students identify and map schoolyard point and nonpoint sources of contaminants. (Part II, step 3).*
- *Students analyze their watershed using Google Earth or similar Geographic Information Systems (GIS) program.*
- *Students compare and analyze map layers to identify schoolyard run-off issues.*
- *Students analyze and discuss the relationship between schoolyard water runoff and bodies of water in the watershed (Wrap Up).*

ESS2.E: Biogeology
Living things affect the physical characteristics of their regions. **(4-ESS2-1)**

- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).*
- *Students identify and map potential point and nonpoint source contaminants. (Part II, step 3).*
- *Students interpret the relationship between the*

Crosscutting Concept(s)

Patterns
Patterns can be used as evidence to support an explanation. **(4-ESS1-1), (4-ESS2-2)**

- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students compare mapped predictions to mapped observations and measurements.*
- *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).*
- *Students write summaries describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).*
- *Students compare and analyze map layers to identify schoolyard run-off issues.*
- *Students analyze their watershed using Google Earth or similar Geographic Information Systems (GIS) program.*
- *Students trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)*

Cause and Effect
Cause and effect relationships are routinely identified, tested, and used to explain change. **(4-ESS2-1)**

- *Students predict and/or observe water flow over the school grounds (Part II, step 4).*
- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students compare mapped predictions to mapped observations and measurements.*
- *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).*

vegetation, collects in depressions and flows off school property. (Part III, step 3). • *Students use a digital map program to trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)* • *Students analyze and discuss the relationship between schoolyard water runoff and bodies of water in the watershed (Wrap Up).*	*runoff and bodies of water in your watershed (Wrap Up).* • *Students analyze their watershed using Google Earth or similar Geographic Information Systems (GIS) program.* • *Students investigate solutions to resolve water flow and/or quality issues on the schoolyard.*	• *Students use a digital map program to trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)* • *Students analyze and discuss the relationship between schoolyard water runoff and bodies of water in the watershed (Wrap Up).*

NGSS Common Core Connections:

ELA/Literacy –

RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)
RI.4.7	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1)
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, paraphrase, and categorize information, and provide a list of sources. (4-ESS2-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (4-ESS2-1), (4-ESS3-2)
MP.4	Model with mathematics. (4-ESS2-1), (4-ESS3-2)
MP.5	Use appropriate tools strategically. (4-ESS2-1)
4.MD.A	Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1), (4-ESS2-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success

Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Use data to evaluate and refine design solutions.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Energy and Matter	Energy and Matter: Students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.

Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

Rainy-Day Hike correlates pretty well *as written* to the 4th grade NGSS Performance Expectations 4-ESS2-1 and 4-ESS2-2 after editing activity elements based on correlation reviewer suggestions. Most of the gray areas can be addresses by modifying or replacing existing directions within the activity text, but some gray areas will not connect without a solid revision to the activity as suggested in the outline below.

Correlations to 4-ESS3-2 were removed upon the recommendation of correlation reviewers, but bundling use of 'Rainy Day Hike' with 'Storm Water' would provide a very strong correlation to all elements building toward the PE.

Suggest realigning the activity as follows:

Warm-up – Upper Grades
- Students study a map of their school grounds and identify features they recognize. (Grade 2)

Part I: Mapping Water Flow
- Students create a map of the school grounds using mapping skills (Part I, steps 3-4).
- Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).
- Students predict water flow over the school grounds (Part II, step 4).
- Students compare mapped predictions to mapped observations and measurements.
- Students identify areas where water flow is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).
- Students write summaries describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).

Part II: Watershed Connections
- Students use a digital map program to trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)
- Students identify the watershed in which their school is located using a digital map program.
- Students analyze and discuss the relationship between schoolyard water runoff and bodies of water in the watershed (Wrap Up).

Part III: ActionEducation
- Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).
- Students identify and map schoolyard point and nonpoint sources of contaminants. (Part II, step 3).
- Students compare and analyze map layers to identify schoolyard run-off issues.
- Students compare their map layers to Google Earth or similar Geographic Information Systems (GIS) program.
- Students analyze their watershed using Google Earth or similar Geographic Information Systems (GIS) program.

Students investigate solutions to resolve water flow and/or quality issues on the schoolyard.

Project WET: Rainy-Day Hike

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	**MS-ESS3** **Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 169
Brief Lesson Description: Students are introduced to urban watershed concepts and storm water issues through an investigation of school buildings and grounds.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).* • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students identify and map potential point and nonpoint source contaminants. (Part II, step 3).* • *Students interpret the relationship between the runoff and bodies of water in your watershed (Wrap Up).* • *Students investigate solutions to resolve water flow and/or quality issues on the schoolyard.*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).* • *Students identify areas where water flow is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students identify and map potential point and nonpoint source contaminants. (Part II, step 3).* • *Students write summaries describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).* • *Students use a digital map program to trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)* • *Students analyze and discuss the relationship between schoolyard water runoff and bodies of water in the watershed (Wrap Up).* • *Students investigate solutions to resolve water flow and/or quality issues on the schoolyard.*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *Students predict and/or observe water flow over the school grounds (Part II, step 4).* • *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).* • *Students compare mapped predictions to mapped observations and measurements.* • *Students identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).* • *Students use a digital map program to trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)* • *Students analyze and discuss the relationship between schoolyard water runoff and bodies of water in the watershed (Wrap Up).* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-3)** • *Students compare their map layers to Google Earth or similar Geographic Information Systems (GIS) program.*
NGSS Common Core Connections: ***ELA/Literacy –*** **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3) **WHST.6-8.8** Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the		

data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3)

Mathematics –

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS3-3)*

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS3-3)*

Connections to other Common Core Standards at this Grade Level: *RH.6-8.2; RH.6-8.7; RST.6-8.2*

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  ◦ that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  ◦ to identify and/or clarify evidence and/or the premise(s) of an argument.
	  ◦ to determine relationships between independent and dependent variables and relationships in models.
	  ◦ to clarify and/or refine a model, an explanation, or an engineering problem.
	  ◦ that require sufficient and appropriate empirical evidence to answer.
	  ◦ that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  ◦ that challenge the premise(s) of an argument or the interpretation of a data set.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB
Rainy-Day Hike correlates well to the MS grade NGSS Performance Expectation MS-ESS3-3 as written. Most of the gray areas can be addressed by modifying or replacing existing directions within the activity text as noted in the gray areas and noted below to include more suggestions for using math and digital tools in the activity. Suggest revising activity to differentiate instructions into parts that build upon each other as 'Color Me a Watershed' is written – i.e., Warm-up of Rainy-Day Hike would have Kindergarteners observing water flow on the school grounds by building boats and using them to follow the flow, while also *observing* where the water flows and what it is carrying. For other grades using this activity, students would be observing the schoolyard and *predicting* where they think water will flow in a storm.	

Part I: Mapping Water Flow could be aimed at 2nd grade and have students mapping the schoolyard using a coordinate system, including measuring the size and relative distances from a central reference point on the schoolyard and between key features on the map. Student teams would then create a digital template – a copy/scan of their map or using a mapping program, as determined by the teacher. Student teams would then draw in their predicted routes of water flow on their maps, including short summaries on why they think the water will flow in these locations based on what they observed on the schoolyard. Students would then revisit the schoolyard after a storm and use a print off of their map template to map the actual flow of water on the schoolyard, then compare their before and after maps and write a summary of how, what and why their maps are similar or different – and noting any potential problems – i.e., puddling, erosion, litter, etc. This would align the activity to correlate with the additional PEs, NGSS dimension elements and CCSS standards shaded in gray in the 2nd grade NGSS document.

Part II: Watershed Connections and all below would be aimed at 4th and 5th grade and expand on the steps above by having students use a program like Google Earth or the National Map to locate their school and the watershed it is located in, then tracing the likely path of water flowing onto and off the schoolyard to the water body where the water will flow into. Students would be asked to brainstorm how observed water flow and any material it was carrying may affect the downstream watershed.

Part III: ActionEducation would have student teams adding to their maps of observed flows across the schoolyard with each team mapping different elements that affect the rate and quality of water flow as it moves across the schoolyard – i.e., measuring the slope of water drainage areas, percentages and location of permeable and impermeable surfaces on the schoolyard, location of downspouts and storm drains, location of vegetation, location of likely contaminant sources (parking lots, garbage cans, etc.). Each team would write up a summary of what they observed, what they think will happen with the elements they mapped in the next storm. Student teams would investigate what occurred with their map elements after a storm, then compare their before and after maps and write a summary of how, what and why their maps are similar or different – and noting any potential problems – i.e., puddling, erosion, litter, etc.)

Student teams would then compare the maps generated by each team to see how data in each teams' map connects to elements in the other team maps to introduce the concept of a Geographic Information System (GIS). Students would use the information to identify water flow and quality issues on the schoolyard and develop potential actions to mitigate or solve each issue. Students would also investigate the GIS mapping elements of Google Earth or the National Map to identify potential water quality issues within their watershed beyond the schoolyard. Student teams would also invite local groups working in the watershed on water quality and storm water issues related to their team map elements to interview and/or talk with the class regarding water quality issues and potential solutions. This would align the activity to correlate with the additional PEs, NGSS dimension elements and CCSS standards shaded in gray in the 4th and 5th grade NGSS documents.

Further development of the ActionEducation component to include development of an assessment of solutions, including a detailed rubric, would connect the activity to the 3–5-ETS1 Engineering Design PEs as well – though I believe this may be better achieved by tweaking elements in *'Just Passing Through'* and *'Storm Water.'* I also highly recommend adding *'Just Passing Through'* to the activities listed in Charting the Course for this activity.

Warm-up – Predicting/Observing

- *Students predict and/or observe water flow over the school grounds (Part II, step 4).*
- *Students work in small groups to observe where water flows on the school grounds.*
- *Students observe and record what is in the water including their boat.*
- *Students draw pictures describing what their tiny boat encountered and where it flowed on the school grounds.*
- *Students list what in the water was from humans and what was from plants, animals or the Earth.*
- *Students discuss how the materials got into the water and how they might affect plants and animals downstream.*
- *Students discuss how to reduce the amount of litter or harmful materials in water on tor leaving the school-yard.*

Part I: Mapping Water Flow

- *Students create a map of the school grounds using mapping skills (Part I, steps 3-4).*
- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students compare mapped predictions to mapped observations and measurements.*
- *Students identify areas where water flow is slowed by landforms and vegetation, collects in depressions and flows off school property. (Part III, step 3).*
- *Students write summaries describing the general pattern of surface water as it flows across the school grounds (Part III, step 3).*

Part II: Watershed Connections

- *Students use a digital map program to trace the likely course of runoff from the school grounds into a local lake or river. (Wrap-up)*
- *Students identify the watershed in which their school is located using a digital map program.*
- *Students analyze and discuss the relationship between schoolyard water runoff and bodies of water in the watershed (Wrap Up).*

Part III: ActionEducation

- *Students measure and map factors that affect water movement (speed and direction) on the school grounds (Part III, step 1).*
- *Students identify and map schoolyard point and nonpoint sources of contaminants. (Part II, step 3).*
- *Students compare and analyze map layers to identify schoolyard run-off issues.*
- *Students compare their map layers to Google Earth or similar Geographic Information Systems (GIS) program.*
- *Students analyze their watershed using Google Earth or similar Geographic Information Systems (GIS) program.*
- *Students investigate solutions to resolve water flow and/or quality issues on the schoolyard.*

Project WET: Reaching Your Limits

* Activities are correlated <u>as written.</u> However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: HS	**Engineering Design**	**Project WET Guide, Page #:** Guide 2.0, p. 371
Brief Lesson Description: By playing a game of limbo, students gain a better understanding of the effort involved in meeting drinking water quality standards— especially when water quality declines.		
Performance Expectation: HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Asking Questions and Defining Problems Analyze complex real-world problems by specifying criteria and constraints for successful solutions. **(HS-ETS1-1)** • *Discuss the results of the game. Ask students to describe feelings they experienced when the pole was lowered too far for them to get under it. What would happen if a treatment plant could not reach the set standards, and how would students know if that happened in their town? Tell students that information is contained in each city's Consumer Confidence Report (CCR), the water quality report that water districts are required by law to publish each year. (Wrap Up)*	**ETS1.A: Defining and Delimiting Engineering Problems** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. **(HS-ETS1-1)** • *Before each student attempts to go under the pole, he or she should pick up a card and read it to the class. Move the bar up three inches (7.5 cm) if the card's message improves the water quality and down three inches (7.5 cm) if the message degrades the quality. The card is reshuffled into the deck. (Part II, Step 4)* • *Instead of water in treatment plants, students can represent aquatic animals and plants that have certain ranges of tolerance. The limbo bar represents water quality. If students can maneuver under the bar, they can tolerate the conditions. If not, the organisms die or must relocate to a suitable new habitat. (Extension)* • *Show students examples of real drinking water standards.* Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **(HS-ETS1-1)** • *Help students access the community's most recent CCR. The report is available from the city water department, on city websites and often in local newspapers. After reviewing the local CCR, ask students to discuss what is contained in the report. Were there any surprises? (Wrap Up)* • *Instead of water in treatment plants, students can represent aquatic animals and plants that have certain ranges of tolerance.*	.... **Connections to Engineering, Technology, and Applications of Science** **Influence of Science, Engineering, and Technology on Society and the Natural World** New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. **(HS-ETS1-1), (HS-ETS1-3)** • *Discuss the results of the game. Ask students to describe feelings they experienced when the pole was lowered too far for them to get under it. What would happen if a treatment plant could not reach the set standards, and how would students know if that happened in their town? Tell students that information is contained in each city's Consumer Confidence Report (CCR), the water quality report that water districts are required by law to publish each year. (Wrap Up)* • *Research and analyze cost data related to water treatment in local communities.*

	The limbo bar represents water quality. If students can maneuver under the bar, they can tolerate the conditions. If not, the organisms die or must relocate to a suitable new habitat. (Extension) • *Students may obtain water test kits and analyze the quality of their school's drinking water. (Extension)* • *Visit a water treatment plant. Have students compare the processes of drinking water treatment and wastewater treatment. (Extension)*	

NGSS Common Core Connections:

ELA/Literacy -

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1),(HS-ETS1-3)

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1), (HS-ETS1-3)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-ETS1-1),*(HS-ETS1-3),(HS-ETS1-4)*

Connections to other Common Core Standards at this Grade Level: ***ELA***: SL.6-12.1 ***Mathematics***: 6.RP.1; 7.RP.2

Additional SEP Connections:	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.
Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3 , acre-feet, etc.)
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Additional Crosscutting Concepts by Grade Level	
Scale, Proportion, and Quantity	Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Correlation Comments	**Correlator Initials:** MJW

At the HS Level:
HS-ESS3-4: This activity has potential to be expanded and meet this standard, but would need more than a little revision. In fact, the activity here would be a good lead in to an activity that truly meets this Performance Expectation. The difference is that Reaching Your Limits gives students awareness of water quality parameters and human systems for water quality control, but this PE is looking for students to design or refine a solution.

HS-ETS1-1 (aligned here) is a better fit, but still needs emphasis on the Wrap Up and Extensions to create a stronger alignment.

At the MS level:
MS-ESS3-3: while not too far off, this PE requires a similar expansion to that outlined for HS-ESS3-4. The PE is more design focused than the activity, but this activity would be a good lead in to a design activity to fit that PE.

Project WET: Seeing Watersheds

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 4	Earth's Systems: Processes that Shape the Earth	Project WET Guide, Page #: Guide 2.0, p. 187

Brief Lesson Description: Students use maps to characterize what a watershed is; to identify the key parts and functions of watersheds; to determine watershed boundaries; to discover how watersheds are named; and to describe how water flows in a watershed based on elevation.

Performance Expectation: 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Performance Expectation: 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Planning and Carrying Out Investigations Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. **(4-ESS2-1)** • *Students conduct an investigation to understand how water flows in a watershed. (Warm Up).* • *Students use a digital mapping program to identify, analyze and define key components their own watershed (Wrap Up).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students use a digital mapping program to delineate and calculate the drainage area(s) within their watershed.* **Analyzing and Interpreting Data:** Analyze and interpret data to make sense of phenomena using logical reasoning. **(4-ESS2-2)** • *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 2-5; Part II, steps 5-6).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students identify, analyze and define key components of their own watershed using a digital mapping program. (Wrap Up).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify and analyze watersheds where water flow was altered by natural events or human activities. (Extension)*	**ESS2.A: Earth Materials and Systems** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. **(4-ESS2-1)** • *Students conduct an investigation to understand how water flows in a watershed. (Warm Up).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify watersheds where water flow was altered by natural events or human activities. (Extensions).* **ESS2.B: Plate Tectonics and Large-Scale System Interactions:** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. **(4-ESS2-2)** • *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 2-5; Part II, steps 5-6).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students identify, analyze and define key components of their own watershed using a*	**Patterns:** Patterns can be used as evidence to support an explanation. **(4-ESS2-2)** • *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 2-5; Part II, steps 5-6).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students identify, analyze and define key components of their own watershed using a digital mapping program. (Wrap Up).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students study how smaller watersheds are contained within larger ones using a digital mapping program. (Extensions).* • *Students identify watersheds where water flow was altered by natural events or human activities. (Extensions).* **Cause and Effect** Cause and effect relationships are routinely identified, tested, and used to explain change. **(4-ESS2-1)** • *Students conduct an investigation to understand how water flows in a watershed. (Warm Up).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify watersheds where water flow was altered by natural events or human activities. (Extensions).*

• *Students study how smaller watersheds are contained within larger ones using a digital mapping program. (Extensions).* • *Students identify watersheds where water flow was altered by natural events or human activities. (Extensions).* • *Students use a digital mapping program to delineate and calculate the drainage area(s) within their watershed.*	*digital mapping program. (Wrap Up).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify watersheds where water flow was altered by natural events or human activities. (Extensions).* • *Students use a digital mapping program to delineate and calculate the drainage area(s) within their watershed.* **ESS2.E: Biogeology** Living things affect the physical characteristics of their regions. **(4-ESS2-1)** • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify watersheds where water flow was altered by natural events or human activities. (Extensions).*	

NGSS Common Core Connections:

ELA/Literacy –

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)

RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1)

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, paraphrase, and categorize information, and provide a list of sources. (4-ESS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (4-ESS2-1)

MP.4 Model with mathematics. (4-ESS2-1), (4-ESS3-2)

MP.5 Use appropriate tools strategically. (4-ESS2-1)

4.MD.A Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions

Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

Seeing Watersheds correlates well to 4th grade NGSS Performance Expectations 4-ESS2-1 and 4-ESS2-2 *as written*, but the activity *could* fully align to all dimensions of PE 4-ESS2-1 ***and*** the NGSS dimensions and CCSS Math components if the modifications in grey are made.

I also suggest revising the activity ending, creating a Part IV that has students applying what they learned in the activity to delineate and analyze their own watershed – through digital and/or print maps – to complete the tasks currently listed in the Wrap-up and Extensions sections of the activity, plus the gray shaded areas.

I also suggest the Wrap-up be a challenge for student teams to investigate other watersheds to apply the knowledge and skills gained in the activity. The existing Wrap-up elements listing information students obtain in their study should be revised as needed to align better with the NGSS elements above – and students' reports should include multimedia elements as noted in the gray shaded text to align with gray shaded CCSS elements in the 5th Grade correlations document for this activity.

I would also recommend developing a future Extension for the activity that challenges students to go more in-depth on using map scales to do a variety of watershed calculations – i.e., better understanding of the math integrated into doing the calculations of area, stream length, etc. on Google Earth and other mapping programs.

I also analyzed MS PEs and found a weak at best correlation to MS-ESS2-4.

Project WET: Seeing Watersheds

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	**Earth's Systems: Processes that Shape the Earth**	**Project WET Guide, Page #:** Guide 2.0, p. 187
Brief Lesson Description: Students use maps to characterize what a watershed is; to identify the key parts and functions of watersheds; to determine watershed boundaries; to discover how watersheds are named; and to describe how water flows in a watershed based on elevation.		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Performance Expectation: 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model using an example to describe a scientific principle. (**5-ESS2-1**) • *Students conduct an investigation to understand how water flows in a watershed. (Warm Up).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students study how smaller watersheds are contained within larger ones using a digital mapping program. (Extensions).* **Using Mathematics and Computational Thinking** Describe and graph quantities such as area and volume to address scientific questions. (**5-ESS2-2**) • *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 4-5; Part II, steps 5-6).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students use a digital mapping program to delineate and calculate the drainage area(s) within their watershed.* • *Students use a digital mapping program to delineate and calculate the drainage area(s) within their watershed.* • *Students identify and analyze the distribution of natural and human designed watercourses and water bodies within their own watershed to using a digital mapping program.*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. (**5-ESS2-1**) • *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 4-5; Part II, steps 5-6).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students identify, analyze and define key components of their own watershed using a digital mapping program. (Wrap Up).* • *Students study how smaller watersheds are contained within larger ones using a digital mapping program. (Extensions).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify and analyze the distribution of natural and human designed watercourses and water bodies within their own watershed to using a digital mapping program.* **ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (**5-ESS2-2**)	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight and volume. (**5-ESS2-2**) • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students study how smaller watersheds are contained within larger ones using a digital mapping program. (Extensions).* • *Students use a digital mapping program to delineate and calculate the drainage area(s) within their watershed.* **Systems and System Models** A system can be described in terms of its components and their interactions. (**5-ESS2-1**), (**5-ESS3-1**) • *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 4-5; Part II, steps 5-6).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students identify, analyze and define key components of their own watershed using a digital mapping program. (Wrap Up).* • *Students study how smaller watersheds are contained within larger ones using a digital mapping program. (Extensions).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.*

• *Students Include multimedia components (e.g., graphics, sound) and visual displays in a presentation summarizing key knowledge on a watershed.* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (**5-ESS3-1**) • *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 4-5; Part II, steps 5-6).* • *Students analyze topographic maps and indicate water flow based on elevation changes (Part III, steps 3-5).* • *Students identify, analyze and define key components of their own watershed using a digital mapping program. (Wrap Up).* • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify and analyze watersheds where water flow was altered by natural events or human activities. (Extension)* • *Students identify and analyze the distribution of natural and human designed watercourses and water bodies within their own watershed to using a digital mapping program.* • *Students Include multimedia components (e.g., graphics, sound) and visual displays in a presentation summarizing key knowledge on a watershed.*	• *Students outline watershed boundaries and identify key watershed components on a map (Part I, steps 4-5; Part II, steps 5-6).* • *Students identify and analyze the distribution of natural and human designed watercourses and water bodies within their own watershed to using a digital mapping program.* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (**5-ESS3-1**) • *Students analyze their own watershed to identify the location of key geological features, land use and vegetation types using a digital mapping program.* • *Students identify and analyze watersheds where water flow was altered by natural events or human activities. (Extension)* • *Students identify and analyze the distribution of natural and human designed watercourses and water bodies within their own watershed to using a digital mapping program.*	• *Students identify and analyze watersheds where water flow was altered by natural events or human activities. (Extension)* • *Students identify and analyze the distribution of natural and human designed watercourses and water bodies within their own watershed to using a digital mapping program.*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2), (5-ESS3-1)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1), (5-ESS2-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
MP.4	Model with mathematics. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigation s	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

Seeing Watersheds correlates well to 5th grade NGSS Performance Expectations 5-ESS2-1 and 5-ESS2-2 with a weaker correlation to 5-ESS3-1 *as written*. The activity alignments to the NGSS dimensions and CCSS Math components *could* be strengthened using the suggested modifications in grey.

I also suggest revising the activity ending, creating a Part IV that has students applying what they learned in the activity to delineate and analyze their own watershed – through digital and/or print maps – to complete the tasks currently listed in the Wrap-up and Extensions sections of the activity, plus the gray shaded areas.

I also suggest the Wrap-up be a challenge for student teams to investigate other watersheds to apply the knowledge and skills gained in the activity. The existing Wrap-up elements listing information students obtain in their study should be revised as needed to align better with the NGSS elements above – and students' reports should include multimedia elements as noted in the gray shaded text to align with gray shaded CCSS elements.

I would also recommend developing a future Extension for the activity that challenges students to go more in-depth on using map scales to do a variety of watershed calculations – i.e., better understanding of the math integrated into doing the calculations of area, stream length, etc. on Google Earth and other mapping programs.

I also analyzed MS PEs and found a weak at best correlation to MS-ESS2-4.

Project WET: A Snapshot in Time

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	Earth and Human Activity/ Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 377
Brief Lesson Description: Students use a topographic (contour) map to explore the concept of a watershed and then apply that knowledge to watershed monitoring. Students will discern the differences in value between an individual data set –collected at one place and time on a watershed- versus a series of water quality data sets collected at various points along a watershed over time. Students will first graph watershed data, then analyze, compare and summarize trends in water quality.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		
Performance Expectation: MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
Performance Expectation: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Performance Expectation: MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Asking Questions and Defining Problems Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **(MS-ETS1-1)** • *Students write an opinion describing why they think water is monitored in a watershed.* • *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.* • *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.* • *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.* • *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).* • *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up).* • *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.* • *Students describe and develop a list of the benefits of long-term data.*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Students write an opinion describing why they think water is monitored in a watershed.* • *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.* • *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.* • *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.* • *Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2).* • *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up).* • *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data.*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.* • *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.* • *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.* • *Students read and interpret a topographic (contour) map to determine the characteristics of a watershed (Part I, steps J-3)* • *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).* • *Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2).* • *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up).* • *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.*

- *Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.)*
- *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* *
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***
- *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.*
- *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

Analyzing and Interpreting Data
Analyze and interpret data to determine similarities and differences in findings. **(MS-ETS1-3)**

- *Students read and interpret a topographic (contour) map to determine the characteristics of a watershed (Part I, steps J-3)*
- *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).*
- *Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2).*
- *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up).*
- *Students use an on-line resource (i.e., Water Monitoring Challenge, USGS Mapper, etc.) to obtain and analyze water quality parameter data chronologically and spatially for a local or state stream.*
- *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.*
- *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* *
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
- *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***
- *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* ****
- *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

ETS1.A: Defining and Delimiting Engineering Problems
The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. **(MS-ETS1-1)**

- *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.*
- *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.*
- *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).*
- *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up).*
- *Students use an on-line resource (i.e., Water Monitoring Challenge, USGS Mapper, etc.) to obtain and analyze water quality parameter data chronologically and spatially for a local or state stream.*
- *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.*
- *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* *
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ETS1-1)**
The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-3), (MS-ETS1-1)**

- *Students read and interpret a topographic (contour) map to determine the characteristics of a watershed (Part I, steps J-3)*
- *Students use an on-line resource (i.e., Water Monitoring Challenge, USGS Mapper, etc.) to obtain and analyze water quality parameter data chronologically and spatially for a local or state stream*
- *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* *
- *Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.)*
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* ****
- *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.*
- *Students evaluate water-monitoring*

• Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring. *** • Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event. **Constructing Explanations and Designing Solutions** Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3) • Students write an opinion describing why they think water is monitored in a watershed. • Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed. • Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter. • Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships. • Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7). • Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up). • Students use evidence from data to describe annual trends in the quality and movement of water in a watershed. • Students describe and develop a list of the benefits of long-term data. • Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.) • Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension) ** • Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring. • Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring. *** • Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations. **** • Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan. • Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.	**ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2), (MS-ETS1-3)** Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. **(MS-ETS1-3)** • Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7). • Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2). • Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up). • Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed. * • Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension) ** • Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring. • Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring. *** • Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations. **** • Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan. • Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event. **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. **(MS-ETS1-3)** • Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7). • Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2).	arguments and revise plans into a class water quality monitoring plan. • Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.

Engaging in Argument from Evidence Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-ETS1-2)** • *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* *** • *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* **** • *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.* • *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*	• *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* * • *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* ** • *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.* • *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* *** • *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* **** • *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.* • *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*	

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3)

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3),(MS-ETS1-1)

WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3),(MS-ETS1-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (MS-ETS1-3)

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3)

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-3)

Connections to other Common Core Standards at this Grade Level: RH.6-8.7; RI.6-12.2; RST.6-12.2; SL.6-12.1; SL.6-12.4; W.7-12.10; WHST.6-12.10; 6.SP.5; 7.SP.1; 7.SP.2; S-IC.1

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Evaluate the accuracy of various methods for collecting data. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. • Collect data about the performance of a proposed object, tool, process or system under a range of conditions.

Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Create algorithms (a series of ordered steps) to solve a problem. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.

Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

A Snapshot in Time correlates pretty well to the MS NGSS Performance Expectations MS-ESS3-3 and MS-ETS1-3 *as written*, but not as well to the connecting CCSS. The suggested modifications in grey and alignment outline below would strengthen correlation to these two PEs, ***and*** to the additional MS PEs - MS-ETS1-1 and MS-ETS1-2 - ***and*** to all connecting CCSS for ***all*** four PEs.

Suggest replacing the existing teacher-centered Q & A Warm-up with a student centered 'taking of their pulse' on what they know and think about water quality monitoring – and letting the students discover the importance of the 4 water quality parameters in the activity. Also highly suggest removing any direction for teachers to *tell* students about the limits of a 'snapshot in time' data vs. gathering multiple data points over time and throughout a river course or watershed – *Let the students discover this for themselves as they do the activity!* This is how I have always run this activity and the self discovery is just as powerful for the teachers as it is for students.

The red bullets and additional suggested notes in green highlight are specifically to enhance correlation to the focus on use of technology and engineering solutions that make optimal use of all available resources in developing monitoring and solution plans at the HS level.

Warm-Up: Introduction to Water Quality Monitoring

- *Students write an opinion describing why they think water is monitored in a watershed.*
- *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.*
- *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.*
- *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.*

Part I: Framing a Snapshot in Time

- *Students read and interpret a topographic (contour) map to determine the characteristics of a watershed (Part I, steps J-3)*
- *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).*

Part II: Understanding the Value of Data

- *Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2).*
- *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap Up).*
- *Students use an on-line resource (i.e., Water Monitoring Challenge, USGS Mapper, etc.) to obtain and analyze water quality parameter data chronologically and spatially for a local or state stream*
- *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.*

Part III: Evaluating Water Monitoring Efforts

- *Students describe and develop a list of the benefits of long-term data.*
- *Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.)*
- *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.**
  *Map should include active USGS stream gauges, identification of active watershed group monitoring sites and identification of municipal or other government monitoring sites and the parameters and schedule of monitoring for each location.
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
  **This should include any information students can locate on costs to monitor including type and brand of equipment used for each test, information discontinued monitoring sites/programs – including inactive USGS or other public access gauges.
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*

Part IV: Developing a Water Monitoring Program

Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.
***Chart should include a ranking based on class discussion and agreement on water quality issues, monitoring needs and limitations – including consideration of inactive programs and/or gauging sites.

- *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* ****
  ****Plans should include use of existing publicly accessible data and/or attempts to restore public access to data and/or reactivation of key programs and/or gauging sites.
- *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.*

Part IV: ActionEducation: Developing a Monitoring Program

- *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

Resources:
USGS Mapper *http://www.monitorwater.org*
World Monitoring Challenge: *http://maps.waterdata.usgs.gov/mapper/index.html*
USGS Water- Quality Field Manual: http://water.usgs.gov/owq/pubs.html
USGS Monitoring Our Rivers & Streams: http://pubs.usgs.gov/fs/fs-077-02/

USGS Selected Water-Quality Topics: http://water.usgs.gov/owq/topics.html

- **Effects of Urbanization on Stream Ecosystems: http://water.usgs.gov/nawqa/urban/**

Project WET: A Snapshot in Time

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: HS	Earth and Human Activity/ Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 377
Brief Lesson Description: Students use a topographic (contour) map to explore the concept of a watershed and then apply that knowledge to watershed monitoring. Students will discern the differences in value between an individual data set –collected at one place and time on a watershed- versus a series of water quality data sets collected at various points along a watershed over time. Students will first graph watershed data, then analyze, compare and summarize trends in water quality.		
Performance Expectation: HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*		
Performance Expectation: HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.		
Performance Expectation: HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Asking Questions and Defining Problems Analyze complex real-world problems by specifying criteria and constraints for successful solutions. **(HS-ETS1-1)** • *Students write an opinion describing why they think water is monitored in a watershed.* • *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.* • *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.* • *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).* • *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap Up).* • *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.* • *Students describe and develop a list of the benefits of long-term data.* • *Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.)* • *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* * • *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **	**ESS3.C: Human Impacts on Earth Systems** Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **(HS-ESS3-4)** • *Students write an opinion describing why they think water is monitored in a watershed.* • *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.* • *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.* • *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.* • *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.* • *Students describe and develop a list of the benefits of long-term data.* • *Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.)* • *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* ** • *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. **(HS-ESS3-4)** • *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.* • *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.* • *Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2).* • *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap-Up).* • *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.* • *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* *** • *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* **** • *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***
- *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.*

Constructing Explanations and Designing Solutions

Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
(HS-ESS3-4), (HS-ETS1-3)

- *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).*
- *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap Up).*
- *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.*
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
- *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***
- *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* ****
- *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.*
- *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.

ETS1.A: Defining and Delimiting Engineering Problems

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
(HS-ETS1-1)

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **(HS-ETS1-1)**

- *Students write an opinion describing why they think water is monitored in a watershed.*
- *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.*
- *Students use an on-line resource (i.e., Water Monitoring Challenge, USGS Mapper, etc.) to obtain and analyze water quality parameter data chronologically and spatially for a local or state stream* *
- *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.*
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***

ETS1.B: Developing Possible Solutions

When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
(HS-ETS1-3), (secondary to HS-ESS3-4)

- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.* ***

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. **(HS-ETS1-1), (HS-ETS1-3)**

Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. **(HS-ESS3-4)**

- *Students read and interpret a topographic (contour) map to determine the characteristics of a watershed (Part I, steps J-3)*
- *Students use an on-line resource (i.e., Water Monitoring Challenge, USGS Mapper, etc.) to obtain and analyze water quality parameter data chronologically and spatially for a local or state stream*
- *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* *
- *Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.)*
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*
- *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* ****
- *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.*
- *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

	• *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* **** • *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.* • *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*	

NGSS Common Core Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS3-4)
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1),(HS-ETS1-3)
RST.11-12.8.a–e	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-4),(HS-ETS1-1),(HS-ETS1-3)
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1),(HS-ETS1-3)

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-ESS3-4),(HS-ETS1-1),(HS-ETS1-3)
MP.4	Model with mathematics. (HS-ETS1-3),(HS-ETS1-4)
N-Q.1-3	Reason quantitatively and use units to solve problems.★ (HS-ESS3-4)

Connections to other Common Core Standards at this Grade Level: RI.6-12.2; RST.6-12.2; SL.6-12.1; SL.6-12.4; W.7-12.10; WHST.6-12.10

Additional SEP Connections: Grades 9-12	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	• Ask questions
	  • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
	  • that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
	  • to determine relationships, including quantitative relationships, between independent and dependent variables.
	  • to clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
	• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. Select appropriate tools to collect, record, analyze, and evaluate data. • Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3 , acre-feet, etc.)
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Scale, Proportion, and Quantity	Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.
Structure and Function	Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
Stability and Change	Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments	**Correlator Initials:** DBB

As written, A Snapshot in Time correlates well to most of the NGSS dimension elements for the HS NGSS Performance Expectations HS-ESS3-4, HS-ETS1-1and HS-ETS1-3, but *not as well* to the DCI at the center of ESS3-4 or the development of criteria and evaluation components of all three PEs. The suggested modifications in grey and alignment outline below would strengthen correlation to the PEs ***and*** to all connecting CCSS.

Suggest replacing the existing teacher-centered Q & A Warm-up with a student centered 'taking of their pulse' on what they know and think about water quality monitoring – and letting the students discover the importance of the 4 water quality parameters in the activity. Also highly suggest removing any direction for teachers to *tell* students about the limits of a 'snapshot in time' data vs. gathering multiple data points over time and throughout a river course or watershed – *Let the students discover this for themselves as they do the activity!* This is how I have always run this activity and the self-discovery is just as powerful for the teachers as it is for students.

The red bullets and additional suggested notes in green highlight are specifically to enhance correlation to the focus on use of technology and engineering solutions that make optimal use of all available resources in developing monitoring and solution plans at the HS level.

Warm-Up: Introduction to Water Quality Monitoring

- *Students write an opinion describing why they think water is monitored in a watershed.*
- *Students discuss their opinions and develop a list of specific reasons why water is monitored in a watershed.*
- *Student teams discuss a key monitoring parameter and develop reasons why they think it is a key parameter.*
- *Students compare their answers to the 'Snapshot in Time Parameter Chart' and note cause & effect relationships.*

Part I: Framing a Snapshot in Time

- *Students read and interpret a topographic (contour) map to determine the characteristics of a watershed (Part I, steps J-3)*
- *Students assess the value of data from a single sample in determining the water quality of a stream (Part I, steps 1-7).*

Part Il: Understanding the Value of Data

- *Students graph, analyze and summarize chronological and spatial water quality data for several parameters (Part II, steps 1-4; Part III, Step 2).*
- *Students compare and contrast the relationship between temperature and dissolved oxygen and the relationship between flow and turbidity (Wrap Up).*
- *Students use an on-line resource (i.e., Water Monitoring Challenge, USGS Mapper, etc.) to obtain and analyze water quality parameter data chronologically and spatially for a local or state stream*
- *Students use evidence from data to describe annual trends in the quality and movement of water in a watershed.*

Part Ill: Evaluating Water Monitoring Efforts

- *Students describe and develop a list of the benefits of long-term data.*
- *Students develop a list of limitations that may impact the quantity and scale of a water-monitoring program (e.g., money, time, accessibility to each site, weather, etc.)*
- *Students use USGS Mapper to develop a topographic map of active water monitoring sites on a nearby stream or throughout the watershed.* *
  *Map should include active USGS stream gauges, identification of active watershed group monitoring sites and identification of municipal or other government monitoring sites and the parameters and schedule of monitoring for each location.
- *Students research water-monitoring efforts and issues in their local watershed to develop benefit, cost and limitation data. (Extension)* **
  **This should include any information students can locate on costs to monitor including type and brand of equipment used for each test, information discontinued monitoring sites/programs – including inactive USGS or other public access gauges.
- *Students graph and apply grade level appropriate calculations to evaluate the benefits and costs involved in water quality monitoring.*

Part IV: Developing a Water Monitoring Program

Students develop a watershed specific chart of prioritized water quality issues, needs and limitations for conducting water quality monitoring.
***Chart should include a ranking based on class discussion and agreement on water quality issues, monitoring needs and limitations – including consideration of inactive programs and/or gauging sites.

- *Students develop an argument and plan for a stream or watershed wide monitoring program, based on evidence and prioritized criteria of water quality issues, needs and limitations.* ****
  ****Plans should include use of existing publicly accessible data and/or attempts to restore public access to data and/or reactivation of key programs and/or gauging sites.
- *Students evaluate water-monitoring arguments and revise plans into a class water quality monitoring plan.*

Part IV: ActionEducation: Developing a Monitoring Program

- *Students activate a student developed water monitoring plan and/or engage in a water quality monitoring event.*

Resources:
USGS Mapper *http://www.monitorwater.org*
World Monitoring Challenge: *http://maps.waterdata.usgs.gov/mapper/index.html*
USGS Water- Quality Field Manual: http://water.usgs.gov/owq/pubs.html
USGS Monitoring Our Rivers & Streams: http://pubs.usgs.gov/fs/fs-077-02/

USGS Selected Water-Quality Topics: http://water.usgs.gov/owq/topics.html

Effects of Urbanization on Stream Ecosystems: http://water.usgs.gov/nawqa/urban/

Project WET: Snow and Tell

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 5	Earth's Systems	Project WET Guide, Page #: Guide 2.0, p. 387
Brief Lesson Description: Students build a model to investigate snowpack runoff patterns and then simulate the process used by the SNOTEL system to collect snow data.		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students use a model to simulate and evaluate variables influencing snowpack runoff timing.* • *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** • *Students discuss the term 'snowpack' and develop a definition based on their discussion.* • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.* • *Students use a model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1)** • *Students discuss the term 'snowpack' and develop a definition based on their discussion.* • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.* • *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*

NGSS Common Core Connections:
ELA/Literacy –

RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-1)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-ESS2-1)
MP.4	Model with mathematics. (5-ESS2-1)
5.G.2	Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.

Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Structure and Function: Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	Correlator Initials: DBB

Part l of Snow and Tell correlates well to the NGSS SEP and CCC dimensions for the 5th grade NGSS Performance Expectation 5-ESS2-1 *as written.* However, the suggested modifications in gray are highlights of existing practices in the activity or suggested enhancements that will strengthen the correlations to all dimensions, connecting CCSS and in particular, the clarification and assessment boundary statements for this PE:

*[Clarification Statement: *****The geosphere, hydrosphere (including ice), atmosphere, and biosphere are each a system and each system is a part of the whole Earth System.*** *Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]*

Below is a flow outline for the suggested modifications in gray for the activity Warm-up and Part l. Please see correlation documents for the rest of the activity.

Warm-up: Defining 'Snowpack'

- *Students discuss the term 'snowpack' and develop a definition based on their discussion.*
- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*

Part I: Modeling Factors of 'Snowpack' Melting

- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students record results of tests for a given 'snowpack' variable based on time and volume measurements.**
- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*

* Refers to measuring the volume of any remnants of 'snowpack' and total runoff for each variable tested. I usually run the activity until the first 'snowfield' is liquefied, then have groups quickly measure the volume of the other sites – or if time needs to be shortened, have students measure all remaining 'packs' at the end of a given time period and just compare volume against length of time.

Project WET: Snow and Tell

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	Earth's Systems/ Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 387
Brief Lesson Description: Students build a model to investigate snowpack runoff patterns and then simulate the process used by the SNOTEL system to collect snow data.		
Performance Expectation: MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.		
Performance Expectation: MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to describe unobservable mechanisms. **(MS-ESS2-4)** • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.* • *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.* • *Students develop a definition for 'snow water equivalency' based on evidence from the simulation.* • *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.* • *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.* • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* **Analyzing and Interpreting Data** Analyze and interpret data to determine similarities and differences in findings. **(MS-ESS3-2)** • *Students compare factors that influence the*	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **(MS-ESS2-4)** Global movements of water and its changes in form are propelled by sunlight and gravity. **(MS-ESS2-4)** • *Students discuss the term 'snowpack' and develop a definition based on their discussion.* • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.* • *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.* • *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.* • *Students develop a definition for 'snow water equivalency' based on evidence from the simulation.* • *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.* • *Students review current 'snowpack' research and compare findings to their watershed model results.*	**Patterns** Graphs, charts, and images can be used to identify patterns in data. **(MS-ESS3-2)** • *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems.* • *Students graph the results to compare snow water equivalency for (3) different densities of snow.* • *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.* • *Students review current 'snowpack' research and compare findings to their watershed model results.* • *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.* • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* • *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.* **Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. **(MS-ESS2-4)** • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students develop a list of variables that may increase or decrease the rate of*

melting of a 'snowpack' by graphing the results of multiple trails. • Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model. • Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition. • Students graph the results to compare snow water equivalency for (3) different densities of snow. • Students develop a definition for 'snow water equivalency' based on evidence from the simulation. • *Students find the average water equivalency for the 'watershed' by adding up the inches of water and dividing by the number of samples. (Extensions)* • Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation. • Students review current 'snowpack' research and compare findings to their watershed model results. • Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy. • Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems. • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* • Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.	• Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems. • Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research. **ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. **(MS-ESS3-2)** • Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram. • Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation. • Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems. • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* • Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research. • *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*	'snowpack' melting and include in their diagram. • Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails. • Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model. • Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow. • Students develop a definition for 'snow water equivalency' based on evidence from the simulation. • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* • Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research. ***Connections to Engineering, Technology, and Applications of Science*** ***Influence of Science, Engineering, and Technology on Society and the Natural World*** *The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.* ***(MS-ESS3-2)*** • Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow. • Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation. • Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy. • Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems. • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* • Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research. • *Students invite a snow scientist or*

		hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)

NGSS Common Core Connections:
ELA/Literacy –
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-2)
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2)
Mathematics –
MP.2 Reason abstractly and quantitatively. (MS-ESS3-2)

Connections to other Common Core Standards at this Grade Level: RST.6-12.3; RST.6-12.4; SL.6-8.1; SL.6-12.4

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. • Evaluate the accuracy of various methods for collecting data.

Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Energy and Matter	Energy and Matter: Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.
Structure and Function	Structure and Function: Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	Correlator Initials: DBB

Snow and Tell correlates well to the MS grade NGSS Performance Expectation MS-ESS2-4 *as written.* However, the suggested modifications in gray are highlights of existing practices in the activity or suggested enhancements that will strengthen the correlations to all dimensions, the connecting CCSS for Language Arts **and** allow correlation to PE MS-ESS3-2, which focuses on natural hazards – Though not specifically listed in the PE clarification, we in California are *very aware* of the natural hazard posed by a rapidly melting snowpack in El Nino rains and lack of a snowpack altogether.

We do not include variables to correlate to all connecting Math CCSS, but it seems like it would be an easy addition to develop – either by use developing the equations or including directions for students to do so.

Below is an flow outline for the suggested modifications in gray for the activity Warm-up and Part I. Please see correlation documents for the rest of the activity.

Warm-up: Defining 'Snowpack'

- *Students discuss the term 'snowpack' and develop a definition based on their discussion.*
- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*

Part I: Modeling Factors of 'Snowpack' Melting

- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students record results of tests for a given 'snowpack' variable based on time and volume measurements.**
- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation*

model.

- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*

* Refers to measuring the volume of any remnants of 'snowpack' and total runoff for each variable tested. I usually run the activity until the first 'snowfield' is liquefied, then have groups quickly measure the volume of the other sites – or if time needs to be shortened, have students measure all remaining 'packs' at the end of a given time period and just compare volume against length of time.

Part ll: Calculating Snow Water Equivalency

- *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.*
- *Students graph the results to compare snow water equivalency for (3) different densities of snow.*
- *Students develop a definition for 'snow water equivalency' based on evidence from the simulation.*
- *Students find the average water equivalency for the 'watershed' by adding up the inches of water and dividing by the number of samples. (Extensions)*

Part Ill: Comparing Results to Reality

- *Students review current 'snowpack' research and compare findings to their watershed model results.*
- *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.*
- *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*

Part IV: ActionEducation

- *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*

Resources:

Snotel Data: http://www.wcc.nrcs.usda.gov/snow/snotel-data.html

Snotel Narrative: http://www.wrcc.dri.edu/cgi-bin/sno_narr3_pl

USGS Current Water Data for the Nation: http://waterdata.usgs.gov/nwis/rt

Southwest Climate Change Network: Mountain Snowpack in the West and Southwest:
http://www.southwestclimatechange.org/impacts/water/snowpack

USGS Fact Sheet: ***'Changes in Streamflow Timing in the Western United States in Recent Decades '***:
http://pubs.usgs.gov/fs/2005/3018/pdf/FS2005_3018.pdf

USGS Fact Sheet: ***'Changes in Streamflow Timing in New England During the 20th Century'***:
http://pubs.usgs.gov/fs/2005/3019/pdf/FS2005_3019.pdf

Project WET: Snow and Tell

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: HS	Earth's Systems/ Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 387
Brief Lesson Description: Students build a model to investigate snowpack runoff patterns and then simulate the process used by the SNOTEL system to collect snow data.		
Performance Expectation: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.		
Performance Expectation: HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.		
Performance Expectation: HS-ESS3–5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model to describe unobservable mechanisms. **(MS-ESS2-4)** • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.* • *Students use a physical model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.* • *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.* • *Students develop a definition for 'snow water equivalency' based on evidence from the simulation.* • *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.* • *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.* • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* **Analyzing and Interpreting Data** Analyze data using tools, technologies, and/or	**ESS2.A: Earth Materials and Systems** Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **(HS-ESS2-2)** • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.* • *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.* • *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.* • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* • *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.* • *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current*	**Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. **(HS-ESS3–5)** Feedback (negative or positive) can stabilize or destabilize a system. **(HS-ESS2-2)** • *Students develop a simple diagram describing 'snowpack' inputs and outputs.* • *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.* • *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.* • *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.* • *Students graph the results to compare snow water equivalency for (3) different densities of snow.* • *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.* • *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)* • *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural*

models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. **(HS-ESS2-2), (HS-ESS3–5)**

- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students graph the results to compare snow water equivalency for (3) different densities of snow.*
- *Students develop a definition for 'snow water equivalency' based on evidence from the simulation.*
- *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.*
- *Students review current 'snowpack' research and compare findings to their watershed model results.*
- *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*

Constructing Explanations and Designing Solutions
Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. **(HS-ESS3-1)**

- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*
- *Students review current 'snowpack' research and compare findings to their watershed model results.*
- *Students graph the results to compare snow water equivalency for (3) different densities of snow.*
- *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.*
- *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.*

research and potential student opportunities to participate. (Extensions)

ESS2.D: Weather and Climate
The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. **(HS-ESS2-2)**

- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*
- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*
- *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*

ESS3.A: Natural Resources
Resource availability has guided the development of human society. **(HS-ESS3-1)**

- *Students discuss the term 'snowpack' and develop a definition based on their discussion.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*
- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*
- *Students find the average water equivalency for the 'watershed' by adding up the inches of water and dividing by the number of samples. (Extensions)*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students describe watershed scale human*

systems based on the results of in class simulations and evidence gathered from research.

Cause and Effect
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **(HS-ESS3-1)**

- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*
- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
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- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*

Patterns
Graphs, charts, and images can be used to identify patterns in data. **(MS-ESS3-2)**

- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems.*
- *Students graph the results to compare snow water equivalency for (3) different densities of snow.*
- *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.*
- *Students review current 'snowpack' research and compare findings to their watershed model results.*

- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*
- *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*

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Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

Science investigations use diverse methods and do not always use the same set of procedures to obtain data. **(HS-ESS3–5)**

New technologies advance scientific knowledge. **(HS-ESS3–5)**

- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.*
- *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.*
- *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*
- *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*

actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.

- *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*

ESS2.C: The Roles of Water in Earth's Surface Processes

Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **(MS-ESS2-4)**

Global movements of water and its changes in form are propelled by sunlight and gravity. **(MS-ESS2-4)**

- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*
- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*

ESS3.B: Natural Hazards

Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. **(HS-ESS3-1)**

- *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*

- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*

Energy and Matter

Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. **(MS-ESS2-4)**

- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*
- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.*
- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*

....

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

Modern civilization depends on major technological systems**. (HS-ESS3-1)**

- *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.*
- *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*
- *Students invite a snow scientist or*

Scientific Knowledge is Based on Empirical Evidence Science knowledge is based on empirical evidence. **(HS-ESS3–5)** Science arguments are strengthened by multiple lines of evidence supporting a single explanation. **(HS-ESS3–5)** • *Students use a physical a model to simulate and compare variables influencing rate of snowpack melting and runoff.* • *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.* • *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.* • *Students graph the results to compare snow water equivalency for (3) different densities of snow.* • *Students review current 'snowpack' research and compare findings to their watershed model results.* • *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.* • *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.* • *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.* • *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.* • *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*	• *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.* • *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.* **ESS3.D: Global Climate Change** Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. **(HS-ESS3–5)** • *Students review current 'snowpack' research and compare findings to their watershed model results.* • *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.* • *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.* • *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.* • *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)* • *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*	*hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*

NGSS Common Core Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS2-2),(HS-ESS3-1),(HS-ESS3–5)
RST.11-12.2	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS2-2),(HS-ESS3–5)
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ESS3–5)
WHST.9–12.1.a–e	Write arguments focused on *discipline-specific content*. (HS-ESS3-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (HS-ESS2-2), (HS-ESS3-1), (HS-ESS3–5)
N-Q.1-3	Reason quantitatively and use units to solve problems. (HS-ESS2-2), (HS-ESS3-1), (HS-ESS3–5)

Connections to other Common Core Standards at this Grade Level: RST.6-12.3; RST.6-12.4; SL.6-8.1; SL.6-12.4

Additional SEP Connections: Grades 9-12	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	• Ask questions
	  • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
	  • that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
	  • to determine relationships, including quantitative relationships, between independent and dependent variables.
	  • to clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
	• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. •
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.

Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3 , acre-feet, etc.)
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	Systems and System Models: Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.
Energy and Matter	Energy and Matter: Students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
Structure and Function	Structure and Function: Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
Stability and Change	Stability and Change: Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments	**Correlator Initials:** DBB

Snow and Tell correlates well to the *intent* and to a number of the *dimensions* of the HS grade NGSS Performance Expectations HS-ESS2-2 *as written.* However, the suggested modifications in gray are highlights of existing practices in the activity or suggested enhancements that will strengthen the correlations to all dimensions, *all* connecting CCSS **and** allow correlation to PEs HS-ESS3-1 and HS-ESS3–5 – both of which focus on The impact of climate change – and as noted in the MS comments, we in California are *very aware* of the climate change threat posed by a rapidly melting snowpack in El Nino rains and lack of a snowpack altogether and I've been using this activity specifically to investigate the factors in the activity in our climate change workshops with our Dept. of Water Resources climate researchers.

Below is an flow outline for the suggested modifications in gray for the activity Warm-up and Part I. Please see correlation documents for the rest of the activity.

Warm-up: Defining 'Snowpack'
- *Students discuss the term 'snowpack' and develop a definition based on their discussion.*
- *Students develop a simple diagram describing 'snowpack' inputs and outputs.*
- *Students develop a list of variables that may increase or decrease the rate of 'snowpack' melting and include in their diagram.*

Part I: Modeling Factors of 'Snowpack' Melting
- *Students use a model to simulate and compare variables influencing rate of snowpack melting and runoff.*
- *Students record results of tests for a given 'snowpack' variable based on time and volume measurements.**
- *Students compare factors that influence the melting of a 'snowpack' by graphing the results of multiple trails.*
- *Students create a series of revised snowpack diagrams showing inputs and outputs between Earth systems based on evidence from the simulation model.*
- *Students write a summary of their results and describe the impact on a watershed based on the simulation evidence, including a revised 'snowpack' definition.*

* Refers to measuring the volume of any remnants of 'snowpack' and total runoff for each variable tested. I usually run the activity until the first 'snowfield' is liquefied, then have groups quickly measure the volume of the other sites – or if time needs to be shortened, have students measure all remaining 'packs' at the end of a given time period and just compare volume against length of time.

Part ll: Calculating Snow Water Equivalency
- *Students simulate SNOTEL methods to calculate snow water equivalency for (3) different densities of snow.*
- *Students graph the results to compare snow water equivalency for (3) different densities of snow.*
- *Students develop a definition for 'snow water equivalency' based on evidence from the simulation.*

- *Students find the average water equivalency for the 'watershed' by adding up the inches of water and dividing by the number of samples. (Extensions)*

Part III: Comparing Results to Reality

- *Students review current 'snowpack' research and compare findings to their watershed model results.*
- *Students compare SNOTEL data from a local site or area summary to the results of their SNOTEL simulation.*
- *Students evaluate the accuracy of their simulated results to current research and suggest modifications to improve accuracy.*
- *Students summarize the trends related to 'snowpack' and watershed function from their review of current research, including risks to natural and human systems.*

Part IV: ActionEducation

- *Students invite a snow scientist or hydrologist from NRCS to visit their class to discuss snow survey technology, current research and potential student opportunities to participate. (Extensions)*
- *Students test additional climate variables that could affect runoff based on their review of current research (Extensions)*
- *Students describe watershed scale human actions that may help conserve 'snowpack' and reduce risk to human and natural systems based on the results of in class simulations and evidence gathered from research.*

Resources:

Snotel Data: http://www.wcc.nrcs.usda.gov/snow/snotel-data.html

Snotel Narrative: http://www.wrcc.dri.edu/cgi-bin/sno_narr3_pl

USGS Current Water Data for the Nation: http://waterdata.usgs.gov/nwis/rt

Southwest Climate Change Network: Mountain Snowpack in the West and Southwest:
http://www.southwestclimatechange.org/impacts/water/snowpack

USGS Fact Sheet: ***'Changes in Streamflow Timing in the Western United States in Recent Decades '***:
http://pubs.usgs.gov/fs/2005/3018/pdf/FS2005_3018.pdf

USGS Fact Sheet: ***'Changes in Streamflow Timing in New England During the 20th Century'***:
http://pubs.usgs.gov/fs/2005/3019/pdf/FS2005_3019.pdf

Project WET: Sparkling Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 5 (including Engineering 3-5 alignment)	EARTH'S SYSTEMS and EARTH AND HUMAN ACTIVITY	Project WET Guide, Page #: Guide 1.0, p. 348
Brief Lesson Description: Students develop strategies to remove contaminants from "wastewater."		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Performance Expectation: 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Experiment with cleaning "wastewater" and simultaneously model some of the steps in wastewater treatment (Activity, Part 1)—the comparison between what the students are doing and the steps in wastewater treatment could be emphasized more.* • *Compare how water is cleaned in the water cycle to steps students took to clean their wastewater to how it is cleaned in a wastewater treatment plant (Warm Up and Wrap Up).* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • *Research general or local water treatment methods. (Activity, Part 1)* • *Visit a water treatment plant and a wastewater treatment plant or have representatives from these agencies speak to the class. (Extension)* **Asking Questions and Defining Problems** Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. **(3-5-ETS1-1)** • *Ask students to write a paragraph or draw a picture describing how they think wastewater is cleaned. (Warm Up)* • *The groups should write down the procedures they plan to use to clean the*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** • *Ask students to describe the water cycle. Within the water cycle, where do students think water can be cleaned? Discuss filtering, settling, and distillation processes. (Warm Up)* **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Discuss what might be in wastewater and historical human impact (Warm Up)* **ETS1.A: Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1)** • *Discussion of water cycle and water treatment systems (Warm Up and Wrap Up)* A system can be described in terms of its components and their interactions. **(5-ESS3-1)** • *Discussion of water cycle and water treatment systems (Warm Up and Wrap Up)* ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Research general or local water treatment methods. (Activity, Part 1)* **Influence of Science, Engineering, and Technology on Society and the Natural World** People's needs and wants change over time, as do their demands for new and improved technologies. **(3-5-ETS1-1)** • *Material from background should be discussed in the Warm Up (about how our understanding of water treatment and why it is needed has changed over time). (Warm Up)*

water. (Activity, Step 4)—this could be more explicitly tied into an engineering design process	meets the specified criteria for success or how well each takes the constraints into account. **(3-5-ETS1-1)** • *Students design and test methods for cleaning water using the given materials. Could be turned into more of a competition where design solutions are compared. (Activity, Parts 1-8)*	

NGSS Common Core Connections:

Common Core State Standards Connections:

ELA/Literacy -

RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-ESS2-1),(5-ESS2-2)*
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-ESS2-1),(5-ESS2-2)*

Mathematics -

MP.2	Reason abstractly and quantitatively. *(5-ESS2-1)*,(5-ESS2-2)
MP.4	Model with mathematics. *(5-ESS2-1)*,(5-ESS2-2)
5.G.A.2	Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. *(5-ESS2-1)*

Common Core State Standards Connections:

ELA/Literacy -

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-ESS3-1)*
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1)
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. *(5-ESS3-1)*

Mathematics -

MP.2	Reason abstractly and quantitatively. *(5-ESS3-1)*

Common Core State Standards Connections:

ELA/Literacy -

W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1),(3-5-ETS1-3)*
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1),(3-5-ETS1-3)*

Mathematics -

MP.2	Reason abstractly and quantitatively. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.4	Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.5	Use appropriate tools strategically. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
3-5.OA	Operations and Algebraic Thinking *(3-ETS1-1),(3-ETS1-2)*

Additional SEP Connections: Grades 3-5	
Planning and Carrying Out Investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Use data to evaluate and refine design solutions.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	**Correlator Initials:**
Possible NGSS alignments *K-ESS2-2 (DCI ESS3.C)* *K-ESS3-3—this activity is much too involved/dangerous at this level but the concept of using natural cleaners could be introduced* *5-ESS2-1** *5-ESS3-1** *3-5-ETS1-1?* *MS-PS1-2?* *MS-LS2-1? (in relation to extension about microbes using oxygen)* *MS-LS2-4? (may not align—concept may be addressed)* *MS-LS2-5** *MS-ESS2-4* *MS-ESS3-3* *MS-ESS3-4* *HS-LS2-7* *HS-ESS3-4*	

Project WET: Springing Into Action

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	Motion and Stability: Forces and Interactions Earth Systems	Project WET Guide, Page #: Guide 2.0, p. 203
Brief Lesson Description: Students actively simulate the process of water infiltrating down-gradient through varying soil layers, saturating the soil above an impermeable layer, flowing along an impermeable layer and naturally exiting the ground at a spring.		
Performance Expectation: 5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.		
Performance Expectation: 5-ESS2-1: Develop a model using an example to describe the ways the geosphere, biosphere, hydrosphere and/or atmosphere interact.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Support an argument with evidence, data, or a model. **(5-PS2-1)** • *Students are asked to describe a spring and how it is formed. (Warm Up)* • *After an object is tossed into the air, students are asked why it came back down. (Warm Up)* • *Students are asked to predict which of three containers with soil, has water moving through it fastest. (Warm Up)* **Developing and Using Models** Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Students are challenged to engineer a spring in a bottle. (Part I, Step 4)* • *Students become gravel, sand or clay in a whole group role play demonstration of water through soil layers. (Part II, Steps 4-9)*	**PS2.B: Types of Interactions** The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. **(5-PS2-1)** • *After an object is tossed into the air, students are asked why it came back down. (Warm Up)* • *Students are then asked if they can relate their understanding of how water moves downhill on the surface of the land to how it moves under the ground. (Warm Up)* **ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** • *Students are asked to think about how water behaves on the Earth's surface compares to how it behaves underground. (Hydrosphere) (Warm Up)* • *Students are asked to compare different soil layers and the rate at which water moves through the*	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change **(5-PS2-1)** • *After an object is tossed into the air, students are asked why it came back down. (Warm Up)* • *Students are asked to predict which of three containers with soil, has water moving through it fastest. (Warm Up)* **Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1)** • *Students are then asked if they can relate their understanding of how water moves downhill on the surface of the land to how it moves under the ground. (Warm Up)* • *Students are asked to think about how water behaves on the Earth's surface compares to how it behaves underground. (Hydrosphere) (Warm Up)* • *Students are asked to compare different soil layers and the rate at which water moves through the system to ultimately form a spring. (Geosphere) (Part I, Step 5)* *NOTE: The terminology of hydrosphere and geosphere are NOT used in this WET activity as they are in the NGSS PE.* • *Students become gravel, sand or clay in a whole group role play demonstration*

	system to ultimately form a spring. (Geosphere) (Part I, Step 5) *NOTE: The terminology of hydrosphere and geosphere are NOT used in this WET activity as they are in the NGSS PE.*	*of water through soil layers. (Part II, Steps 4-9)*

NGSS Common Core Connections:
ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-PS2-1)
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-PS2-1)
W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-PS2-1)

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-ESS2-1)*
SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-ESS2-1)*

Mathematics –
MP.2 Reason abstractly and quantitatively. *(5-ESS2-1)*
MP.4 Model with mathematics. *(5-ESS2-1)*
5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in context of the situation. *(5-ESS2-1)*

Connections to other Common Core Standards at this Grade Level: SL.5.1, SL.5.2, SL.5.4

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success

Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

Correlation Comments	Correlator Initials: ELC

Springing Into Action has two parts that both include making models—Part I is about making a model with a two-liter soda bottle and Part II involves a whole body activity, role-playing soil layers and the formation of a spring. 5-PS2-1 mentioned above could help to support an "argument" and example of gravity. 5-ESS2-1 could relate the geosphere to the hydrosphere through the water cycle, although that connection must be made explicitly to students. This activity doesn't specifically make the connection between water and soil as being hydrosphere and geosphere.

Part I also seems like it would be a good fit for an Engineering PE, but it isn't completely, as written. There is the suggestion of allowing student groups to make their own spring system, but the activity instructions then go ahead and tell exactly how to make the demo that would be shown to students. I do think teachers need the demo information, but if we give them a sheet that shows every layer and we give students a demo/example of what they are supposed to make, then there isn't much room for interpretation or differing ideas/models. Part I, Step 4 is a good suggestion, but the rest of the activity doesn't allow for student thought development. With that said, here is the NGSS PE that could be linked to this activity:

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Another possible link is to 4-ESS2-1 and 4-ESS2-2, although this activity is too in depth (underground vs. phenomena they can see above ground). It could serve as an extension to these two PEs:

4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or rates of erosion by water, ice, wind, or vegetation. (mentions downhill slopes, etc.)

4-ESS2-2: Analyze and interpret data from maps to describe patterns of Earth's features. (mentions topo maps of land, ocean floors, etc.)

DBB: Agree with Erica the activity does a decent job correlating as written to the elements of both PEs. Would suggest inserting gray language to have students sketch their understanding of how water moves above and under ground, rather than just 'ask' as it is wriiten in the activity. They would then actually be developing a model on their own and would be able to record their understanding of components and interactions, which would be a more solid connection to the CCCs - and this initial model can be revisited and revised during or after the activity. Not as concerned about the lack of use of the NGSS vocabulary - geosphere & hydrosphere. This would be just one of multiple tools a teacher would use to address the PEs, and I'm going under the assumption teachers will be making sure to connect the NGSS vocabulary to the everyday terms that fall under either word.

Project WET: Springing Into Action

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	**Earth's Systems**	**Project WET Guide, Page #:** Guide 2.0, p. 203
Brief Lesson Description: Students actively simulate the process of water infiltrating down-gradient through varying soil layers, saturating the soil above an impermeable layer, flowing along an impermeable layer and naturally exiting the ground at a spring.		
Performance Expectation: MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by the energy from the sun and the force of gravity.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. **(MS-ESS2-4)** • *Students are asked if they can relate their understanding of how water moves downhill on the surface of the land to how it moves under the ground. (Warm Up)* • *Students are asked to think about how water behaves on the Earth's surface compares to how it behaves underground. (Warm Up)* • *Students are challenged to engineer a spring in a bottle. (Part I, Step 4)* • *Students are asked to compare different soil layers and the rate at which water moves through the system to ultimately form a spring. (Part I, Step 5)* • *Students become gravel, sand or clay in a whole group role play demonstration of water through soil layers. (Part II, Steps 4-9)*	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. **(MS-ESS2-4)** • *Students are asked to think about how water behaves on the Earth's surface compares to how it behaves underground. (Warm Up)* Global movements of water and its changes in form are propelled by sunlight and gravity. **(MS-ESS2-4)** • *After an object is tossed into the air, students are asked why it came back down. (Warm Up)* • *Students are then asked if they can relate their understanding of how water moves downhill on the surface of the land to how it moves under the ground. (Warm Up)*	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. **(MS-ESS2-4)**
NGSS Common Core Connections: ***ELA/Literacy – None listed for MS-ESS2-4*** ***Mathematics – None listed for MS-ESS2-4*** **Connections to other Common Core Standards at this Grade Level:** RST.6-8.3, SL.6-8.1, SL.6-8.2, SL.6-8.4; WHST.6-8.7		

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Energy and Matter	Energy and Matter: Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.

Correlation Comments	**Correlator Initials:** ELC

Springing Into Action has two parts that both include making models—Part I is about making a model with a two-liter soda bottle and Part II involves a whole body activity, role-playing soil layers and the formation of a spring. This activity doesn't specifically address the "energy" portion of the NGSS PE and the Energy and Matter portion of the Cross-Cutting Concepts, as written, so those pieces are marked in gray.

Part I also seems like it would be a good fit for an Engineering PE, but it isn't completely, as written. There is the suggestion of allowing student groups to make their own spring system, but the activity instructions then go ahead and tell exactly how to make the demo that would be shown to students. I do think teachers need the demo information, but if we give them a sheet that shows every layer and we give students a demo/example of what they are supposed to make, then there isn't much room for interpretation or differing ideas/models. Part I, Step 4 is a good suggestion, but the rest of the activity doesn't allow for student thought development. With that said, here is the NGSS PE that could be linked to this activity:

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

The areas in gray above on the SEP table are related to this NGSS PE and could be accomplished, if the activity was changed slightly to focus more on the engineering piece of Part I, Step 4.

Another possible link is to MS-ESS3-1 (see below), although there is really nothing currently in the activity to lead to this discussion—it would have to be much more explicit, but answering questions such as "Why do some areas of the country/world have springs and others do not? (soil types) would be a nice start to thinking about the availability of water resources throughout the country and world too.

MS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy and groundwater resources are the result of past and current geoscience processes.

Project WET: Storm Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 4	Earth and Human Activity/ Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 395
Brief Lesson Description: Students learn how water travels through a community and how it can be managed. Students learn methods that city planners, water managers and land owners use that can reduce the impact of storm water runoff. Students use household sponges to simulate how storm water runoff can be captured, stored and released.		
Performance Expectation: 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*		
Performance Expectation: 3–5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.		
Performance Expectation: 3–5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Asking Questions and Defining Problems Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. **(3–5-ETS1-1)** • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students examine current storm water practices in their school and create a plan to implement or enhance a storm water BMP. (Extensions)* **Constructing Explanations and Designing Solutions** Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. **(4-ESS3-2), (3–5-ETS1-2)** • *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).*	**ESS3.B: Natural Hazards** A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. **(4-ESS3-2)** • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students examine current storm water practices in their school and create a plan to implement or enhance a storm water BMP. (Extensions)* **ETS1.A: Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **(3–5-ETS1-1)** • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students make a chart to compare features of the BMPs in the activity.*	**Cause and Effect** Cause and effect relationships are routinely identified, tested, and used to explain change. **(4-ESS3-2)** • *Students observe and describe similarities and differences in surface features on their school grounds.* • *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.* • *Students describe materials observed in and around a storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students examine current storm water practices in their school and create a plan to implement or enhance a storm water BMP. (Extensions)*

• *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students make a chart comparing groups' results, including a summary the BMPs they used and final runoff volume.* • *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students examine current storm water practices in their school and create a plan to implement or enhance a storm water BMP. (Extensions)*	• *Students compare the measured volume of water runoff to analyze differences in surface feature properties.* • *Students compare the volume of runoff to the area of surface types using a graph.* • *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students examine current storm water practices in their school and create a plan to implement or enhance a storm water BMP. (Extensions)* **ETS1.B: Developing Possible Solutions** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. **(3–5-ETS1-2)** At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. **(3–5-ETS1-2)** Testing a solution involves investigating how well it performs under a range of likely conditions. **(secondary to 4-ESS3-2)** • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).* • *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students examine current storm water practices in their school and create a plan to implement or enhance a storm water BMP. (Extensions)*	.... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The People's needs and wants change over time, as do their demands for new and improved technologies. **(3–5-ETS1-1)** Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. **(3–5-ETS-2)** • *Students observe and describe similarities and differences in surface features on their school grounds.* • *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.* • *Students describe materials observed in and around a storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students examine current storm water practices in their school and create a plan to implement or enhance a storm water BMP. (Extensions)*

NGSS Common Core Connections:
ELA/Literacy –
RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)
RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)
Mathematics –
MP.2 Reason abstractly and quantitatively. (4-ESS3-2),(3–5-ETS1-1),(3–5-ETS1-2)
MP.4 Model with mathematics. (4-ESS3-2),(3–5-ETS1-1),(3–5-ETS1-2)
MP.5 Use appropriate tools strategically. (3–5-ETS1-1),(3–5-ETS1-2)

Connections to other Common Core Standards at this Grade Level: 4.MD.2

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

The content and practices at the core of Part I and II of Storm Water correlates well to the 4th grade NGSS Performance Expectations 4-ESS3-2, 3–5-ETS1-1 and 3–5-ETS1-2, but the activity action items have weak correlations *as written.* The majority of the modifications in gray and suggested outline to re-align the activity below are highlights of student action items, integration of extensions and enhancement of action items already existing in the activity. This correlation is just to Part I & II for this activity, as Part III is targeted at PEs at higher grade levels.

The suggested modifications would also correlate the activity to the majority of the connecting CCSS, though Math remains an issue.

Warm-up: Assessing the Landscape

- *Students observe and describe similarities and differences in surface features on their school grounds.*
- *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.*
- *Students describe materials observed in and around a storm drain.*
- *Students predict how storm water impacts a natural landscape and a human-made cityscape.*
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Part I: Properties of Surfaces

- *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).*
- *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)*
- *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).*

Part ll: Introduction to Best Management Practices (BMPs)

- *Students use a simple model to simulate the movement of water in an urban landscape.*
- *Students compare the measured volume of water runoff to analyze differences in surface feature properties.*
- *Students compare the volume of runoff to the area of surface types using a graph.*
- *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).*
- *Students make a chart to compare features of the BMPs in the activity.*
- *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.*

Part IV: ActionEducation: Planning the Use of BMPs

Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)

Project WET: Storm Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 5	Earth's Systems/ Earth and Human Activity/ Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 395
Brief Lesson Description: Students learn how water travels through a community and how it can be managed. Students learn methods that city planners, water managers and land owners use that can reduce the impact of storm water runoff. Students use household sponges to simulate how storm water runoff can be captured, stored and released.		
Performance Expectation: 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Performance Expectation: 3–5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.		
Performance Expectation: 3–5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Asking Questions and Defining Problems Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. **(3–5-ETS1-1)** • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)* **Developing and Using Models** Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** • *Students conduct simple tests to observe*	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** • *Students observe and describe similarities and differences in surface features on their school grounds.* • *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3).* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students research the use of a BMP as a solution to storm water management in*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS2-1), (5-ESS3-1)** • *Students observe and describe similarities and differences in surface features on their school grounds.* • *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3).*

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(Extensions) • Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3). • Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3). • Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions) **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** • Students make a chart to compare features of the BMPs in the activity. • Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment. • Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity. • Students research the use of a BMP as a	urban environments. (Extensions) • Students use their rubric to compare their research and evaluate the current use of storm water BMPs. • Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community. • Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions) **ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • Students observe and describe similarities and differences in surface features on their school grounds. • Students note surface features as they diagram the likely movement of water from schoolyard to storm drain. • Students describe materials observed in and around a storm drain. • Students predict how storm water impacts a natural landscape and a human-made cityscape. • Students make a chart to compare features of the BMPs in the activity. • Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment. • Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions) • Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions) • Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3). • Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions) **ETS1.A: Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **(3–5-ETS1-1)** • Students develop a rubric of criteria to assess	• Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions) • Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity. • Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions) • Students use their rubric to compare their research and evaluate the current use of storm water BMPs. • Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community. • Students examine current storm water practices and create a plan to implement or enhance storm water BMPs in their homes, school and/or community. (Extensions) ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The People's needs and wants change over time, as do their demands for new and improved technologies. **(3–5-ETS1-1)** Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. **(3–5-ETS-2)** • Students observe and describe similarities and differences in surface features on their school grounds. • Students note surface features as they diagram the likely movement of water from schoolyard to storm drain. • Students describe materials observed in and around a storm drain. • Students explain how storm water impacts a natural landscape and a human-made cityscape. • Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity. • Students research the use of a BMP as a solution to storm water management in urban environments. 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solution to storm water management in urban environments. (Extensions)

- *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.*
- *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.*
- *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)*

Constructing Explanations and Designing Solutions

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. **(3–5-ETS1-2)**

- *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).*
- *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)*
- *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).*
- *Students use a simple model to simulate the movement of water in an urban landscape.*
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- *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).*
- *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.*
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- *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.*
- *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.*
- *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)*

ETS1.B: Developing Possible Solutions

Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. **(3–5-ETS1-2)**

At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. **(3–5-ETS1-2)**

- *Students make a chart to compare features of the BMPs in the activity.*
- *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.*
- *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.*
- *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)*
- *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.*
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- *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)*
- *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)*

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Connections to Nature of Science

Science Addresses Questions About the Natural and Material World

Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)**

- *Students predict how storm water impacts a natural landscape and a human-made cityscape.*
- *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).*
- *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)*
- *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).*
- *Students use a simple model to simulate the movement of water in an urban landscape.*
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- *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)*
- *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS2-1), (5-ESS3-1),(3–5-ETS1-2)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1),(3–5-ETS1-2)
RI.5.9.a,b	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1), (3–5-ETS1-2)
SL.5.5	Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1)

W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3–5-ETS1-1)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1),(3–5-ETS1-1)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1),(3–5-ETS1-1)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS3-1), (3–5-ETS1-1), (3–5-ETS1-2)
MP.4	Model with mathematics. (5-ESS2-1), (5-ESS3-1), (3–5-ETS1-1), (3–5-ETS1-2)
MP.5	Use appropriate tools strategically. (3–5-ETS1-1), (3–5-ETS1-2)
5.OA.1-2.1	Write and interpret numerical expressions. (3–5-ETS1-1), (3–5-ETS1-2)
5.OA.3	Analyze patterns and relationships. (3–5-ETS1-1), (3–5-ETS1-2)

Connections to other Common Core Standards at this Grade Level: 4.MD.2

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Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
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Correlation Comments	Correlator Initials: DBB

The content and practices at the core of Storm Water correlates well to the 5th grade NGSS Performance Expectations 5-ESS2-1, 5-ESS3-1, 3–5-ETS1-1 and 3–5-ETS1-2, but the activity action items do not *as written.* The majority of the modifications in gray and suggested outline to re-align the activity below are highlights of student action items, integration of extensions and enhancement of action items already existing in the activity. There are a couple of suggested additions – i.e., development of a rubric to assess BMPs, including side benefit of a BMP to increase urban biodiversity – that are key to correlating the activity to all three PEs.

The suggested modifications would also correlate the activity to the majority of the connecting CCSS.

Warm-up: Assessing the Landscape

- *Students observe and describe similarities and differences in surface features on their school grounds.*
- *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.*
- *Students describe materials observed in and around a storm drain.*
- *Students predict how storm water impacts a natural landscape and a human-made cityscape.*
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Part I: Properties of Surfaces

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- *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)*
- *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).*

Part lI: Introduction to Best Management Practices (BMPs)

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- *Students compare the measured volume of water runoff to analyze differences in surface feature properties.*
- *Students compare the volume of runoff to the area of surface types using a graph.*
- *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).*
- *Students make a chart to compare features of the BMPs in the activity.*
- *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.*

Part III: Assessing the Use of Storm Water BMPs

- *Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3).*
- *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)*
- *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.*
- *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)*
- *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.*
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Part IV: ActionEducation: Planning the Use of BMPs

- Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)

Project WET: Storm Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Earth and Human Activity/ Ecosystems: Interactions, Energy, and Dynamics/ Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 395
Brief Lesson Description: Students learn how water travels through a community and how it can be managed. Students learn methods that city planners, water managers and land owners use that can reduce the impact of storm water runoff. Students use household sponges to simulate how storm water runoff can be captured, stored and released.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*		
Performance Expectation: MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*		
Performance Expectation: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Constructing Explanations and Designing Solutions Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.* • *Students describe materials observed in and around a storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).* • *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students compare the measured volume of water runoff to analyze differences in surface feature properties.* • *Students compare the volume of runoff to the area of surface types using a graph.* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Students describe materials observed in and around a storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students use a simple model to simulate the movement of water in an urban landscape.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)* • *Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3).*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *Students describe materials observed in and around a storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.*

• *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)* **Engaging in Argument from Evidence** Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-LS2-5),(MS-ETS1-2)** • *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)*	• *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)* **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. **(MS-LS2-5)** ***Supplemental DCI PS1.B, ESS3.A, ESS3.C*** • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)* **LS4.D: Biodiversity and Humans** Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. **(*secondary to MS-LS2-5*)** • *Students describe materials observed in and around a storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)* • *Students use their rubric to compare their research and evaluate the current use of*	• *Students examine current storm water practices and create a plan to implement or enhance storm water BMPs in their homes, school and/or community. (Extensions)* **Stability and Change** Small changes in one part of a system might cause large changes in another part. **(MS-LS2-5)** • *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.* • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-3), (MS-LS2-5)** • *Students predict how storm water impacts a natural landscape and a human-made cityscape.* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)*

	storm water BMPs. • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)* **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2),*(secondary to MS-LS2-5)*** • *Students describe materials observed in and around a storm drain.* • *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)* • *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)* • *Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3).* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)*	• *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)* .... ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** Science knowledge can describe consequences of actions but does not necessarily prescribe the decisions that society takes. **(MS-LS2-5)** • *Students explain how storm water impacts a natural landscape and a human-made cityscape.* • *Students make a chart to compare features of the BMPs in the activity.* • *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.* • *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.* • *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)* • *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.* • *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.* • *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)* • *Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)*

NGSS Common Core Connections:
ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-2)
RST.6-8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2)
RI.8.8	Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-5)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-ETS1-2)

Connections to other Common Core Standards at this Grade Level: RST.6-8.2; RST.6-8.3; RST.6-8.4

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.
	• Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data about the performance of a proposed object, tool, process or system under a range of conditions.

Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

The content and practices at the core of Storm Water correlate well to the MS grade NGSS Performance Expectations MS-ESS3-3, MS-LS2-5 and MS-ETS1-2, but the activity action items do not *as written.* The majority of the modifications in gray and suggested outline to re-align the activity below are highlights of student action items, integration of extensions and enhancement of action items already existing in the activity. There are a couple of suggested additions – i.e., development of a rubric to assess BMPs, including side benefit of a BMP to increase urban biodiversity – that are key to correlating the activity to all three PEs.

The suggested modifications would also correlate the activity to all of the connecting CCSS for Language Arts, but correlation to Math remains an issue.

Warm-up: Assessing the Landscape

- *Students observe and describe similarities and differences in surface features on their school grounds.*
- *Students note surface features as they diagram the likely movement of water from schoolyard to storm drain.*
- *Students describe materials observed in and around a storm drain.*
- *Students predict how storm water impacts a natural landscape and a human-made cityscape.*
-

Part I: Properties of Surfaces

- *Students conduct simple tests to observe and describe the characteristics of permeable and impermeable surfaces. (Part I, steps 1-4).*
- *Students make a chart that lists and compares examples of permeable and impermeable surfaces (Part I, Step 4)*
- *Students diagram how water moves on permeable and impermeable surfaces. (Warm Up).*

Part II: Introduction to Best Management Practices (BMPs)

- *Students use a simple model to simulate the movement of water in an urban landscape.*
- *Students compare the measured volume of water runoff to analyze differences in surface feature properties.*
- *Students compare the volume of runoff to the area of surface types using a graph.*
- *Students write a paragraph describing their group's BMPs and how they affected runoff (Part II, steps 2-B).*
- *Students make a chart to compare features of the BMPs in the activity.*
- *Students rank the BMPs based on likely cost, ease of implementation, ability to mitigate storm water and added benefits for the school and/or environment.*

Part III: Assessing the Use of Storm Water BMPs

- *Students identify and develop a map of storm water BMPs located in their community. (Part III, step 3).*
- *Students invite a storm water manager to the classroom to present and discuss how storm water is being managed in the community. (Extensions)*
- *Students develop a rubric of criteria to assess potential BMP impacts, including ability to mitigate storm water runoff, ease of implementation, aesthetics and enhancement of urban biodiversity.*
- *Students research the use of a BMP as a solution to storm water management in urban environments. (Extensions)*
- *Students use their rubric to compare their research and evaluate the current use of storm water BMPs.*
- *Students use their rubric to evaluate and rank the list of BMPs based on likelihood of success if used in their community.*

Part IV: ActionEducation: Planning the Use of BMPs

- Students examine current storm water practices in their school and/or community and create a plan to implement or enhance one or more storm water BMPs. (Extensions)

Project WET: Sum of the Parts

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	**Topic: Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 283
Brief Lesson Description: Students demonstrate how everyone contributes to the pollution of a river as it flows through a watershed and recognize that through individual and group action, the amount of pollution can be reduced.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating and communicating information in 3-5 builds on K-2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. • *Students research and consider land management from another perspective (farmer, suburban dwellers, etc.) and work to answer question—how would they manage land to protect water? (Extension)*	**ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But, individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Students describe land development and identify any actions that might add to or pollute water (Step 4)* • *Students identify sources of point source and non-point source pollution (Wrap Up)* • *Students write paragraph about how they can decrease pollution, following discussion about Best Management Practices (BMPs) (Wrap Up)* • *Students research water regulations for their area and write letter to government officials, if needed. (Wrap Up)*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS3-1)** ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)**
NGSS Common Core Connections: ***ELA/Literacy –*** **RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-ESS3-1)* **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1) (Wrap Up) **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgably. (5-ESS3-1) **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources, summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1) **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection and research. *(5-ESS3-1)*(Wrap Up)		

Mathematics –
MP.2 Reason abstractly and quantitatively. (5-ESS3-1)
MP.4 Model with mathematics. (5-ESS3-1)

Connections to other Common Core Standards at this Grade Level: W.5.4, W.5.7

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system for and includes several criteria success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop and/or use models to describe and/or predict phenomena • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** ELC
Sum of the Parts gets close to addressing 3-5-ETS1-1 and also MS-ETS1-2 (as part of the Assessment). Additionally, it could lead to the following Middle School NGSS: MS-LS2-4, MS-LS2-5 and MS-ESS3-3. As written, it does not really address any NGSS for the MS level. For additional MS SEPs, it addresses the last bullet on Asking Questions, the 6th bullet on Constructing Explanations, Engaging in Argument, last bullet and Obtaining, Evaluating…the last bullet. For additional Cross Cutting Concepts, Cause and Effect and Stability and Change would also be addressed.	

Project WET: Super Bowl Surge

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** Blue text represents the Extension section of the activity..*

<table>
<tr><td>Grade: 5</td><td>Earth and Human Activity/
Engineering Design</td><td>Project WET Guide, Page #:
Guide 2.0, p. 405</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students learn how a stressed wastewater systems can be overwhelmed impact and then do in-depth research and present action plans to solve the problem of increased demands on a community's wastewater treatment plant.</td></tr>
<tr><td colspan="3">Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</td></tr>
<tr><td colspan="3">Performance Expectation: 3–5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</td></tr>
<tr><td>Science & Engineering Practice(s)</td><td>Disciplinary Core Idea(s)</td><td>Crosscutting Concept(s)</td></tr>
<tr><td>Obtaining, Evaluating, and Communicating Information
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)
• Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.
• Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).
• Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.
• Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.
• Students investigate new technologies to alleviate and improve city wastewater collection and treatment systems.
• Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)
• Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).
• Students use persuasive strategies to present a proposal to a panel of judges (Part II, steps 3 and 7).
• Students evaluate proposed plans (Wrap Up).

Constructing Explanations and Designing Solutions
Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3–5-ETS1-2)
• Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for</td><td>ESS3.C: Human Impacts on Earth Systems
Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)
• Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.
• Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).
• Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).
• Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.
• Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.
• Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).

ETS1.B: Developing Possible Solutions
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3–5-ETS1-2)
• Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.
• Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).
• Students graph (or review a graph) of a</td><td>Systems and System Models
A system can be described in terms of its components and their interactions. (5-ESS3-1)
• Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.
• Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).
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• Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)
• Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).

Connections to Nature of Science

Influence of Engineering, Technology, and Science on Society and the Natural World
Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal</td></tr>
</table>

submitting a wastewater solution proposal. • *Students investigate and report on new technologies to alleviate and improve city wastewater collection and treatment systems.* • *Students investigate and report on new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).*	*sewage flow graph for the City of Beaverton.* • *Students investigate and report on new technologies to alleviate and improve city wastewater collection and treatment systems.* • *Students investigate and report on new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. **(3–5-ETS1-2)** • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students investigate and report on new technologies to alleviate and improve city wastewater collection and treatment systems.* • *Students investigate and report on new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students use persuasive strategies to present a proposal to a panel of judges (Part II, steps 3 and 7).* • *Students evaluate proposed plans (Wrap Up).*	demands. **(3–5-ETS1-2)** • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students investigate new technologies to alleviate and improve city wastewater collection and treatment systems.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies to alleviate and improve city wastewater collection and treatment systems.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)*

NGSS Common Core Connections:

ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1), (3–5-ETS1-2)
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1), (3–5-ETS1-2)
RI.5.9.a,b	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1), (3–5-ETS1-2)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1)
W.5.9.a,b	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (5-ESS3-1), (3–5-ETS1-2)
MP.4	Model with mathematics. (5-ESS3-1)

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems. • Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Energy and Matter	Students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.
Structure and Function	Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB
Super Bowl Surge correlates to 5th grade NGSS Performance Expectations 5-ESS3-1 *as written*, but not to the majority of the connecting CCSS. The suggested realignment of the activity outlined below and integration of the modifications in gray would provide a strong correlation to 5-ESS3-1, expand correlation to PE 5-ETS1-2 **and** the CCSS connected to each. The major key is adopting the modifications in gray regarding investigation of new technologies to *'Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem,'* as required by 5-ETS1-2, which would also have the added benefit of having students investigating the most current technologies for improving waster water collection systems. These modifications will also change the activity solution from the current focus on addressing concerns of different groups to a solution that will actually integrate the latest in wastewater collection technology and strategies. In researching this correlation, I uncovered a lot of articles debunking the entire premise of this activity – and some were quite critical of those who	

perpetuate the myth, thus the reason for seeking permission (or writing our own version) of the Daily Beast article and adding an extension option that has students investigating the premise of this activity. I'm suggesting using this article as part of the Warm-up along with a simple diagram of how a municipal wastewater collection system works as a more rigorous, yet still engaging way to get students into the activity – I've included a link to one potential diagram below.

Despite questions about the premise of the activity, I still suggest using it exactly as written currently – It does provide a great introduction and helps specify the community need students will address in the rest of the activity.

The Daily Beast article was very enlightening and does a wonderful job highlighting additional threats to a wastewater collection system that can easily be incorporated into the simulation by including a waste water collector bucket with overflow line and a bucket representing the city, treated water supply. If beads or water were used, students would dump the load from their house (yes, terminology intended) into the treatment plant bucket, then visit the city supply on the way back to their house to represent the water currently used to refill the toilets after flushing.

The activity suggests having students research the impact of low flow toilets on the wastewater collection system, but why not incorporate this into the research and development of their plans – and expanding it to also look at the impacts of – gray water diversion, treatment plant water needs, home water conservation technologies, etc. as well as new wastewater collection system technology/strategies?

Also included a suggestion to include a real or mock graph or data to create a graph for the City of Beaverton's system to meet the math CCSS. The activity already includes a suggestion that students request a copy of this graph for their local system, but there really should be one in the activity for them to view and analyze as well.

Warm-up –
- *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.*

Part I:
- *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).*
- *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).*

Part II:
- *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.*
- *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.*
- *Students investigate new technologies to alleviate and improve city wastewater collection and treatment systems.*
- *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)*

Part III: ActionEducation
- *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* (*Secondary grade levels)*
- *Students develop a plan of action to reduce the demands on a municipal waste water system (Part II, step 2).*
- *Students use persuasive strategies to present a proposal to a panel of judges (Part II, steps 3 and 7).*
- *Students evaluate proposed plans (Wrap Up).*

Extension
- *Students research and develop an argument regarding the issue of the 'Super Bowl Surge.'*

Daily Beast article: *'The Super Bowl of Toilets'*: http://www.thedailybeast.com/articles/2015/01/31/the-super-bowl-of-toilets.html

Potential Diagram
http://capitalregionwater.com/wp-content/uploads/2014/10/CombineWasteWaterOverflow-1024x791.gif

Resources
Primer for Municipal Wastewater Treatment Systems
http://www.epa.gov/sites/production/files/2015-09/documents/primer.pdf

http://time.com/money/3689718/super-bowl-myths-hamburgers-flush-effect/

Project WET: Super Bowl Surge

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Earth and Human Activity/ Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 405
Brief Lesson Description: Students learn how a stressed wastewater systems can be overwhelmed impact and then do in-depth research and present action plans to solve the problem of increased demands on a community's wastewater treatment plant.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*		
Performance Expectation: MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
Performance Expectation: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Asking Questions and Defining Problems Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. **(MS-ETS1-1)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.* • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students evaluate proposed plans (Wrap Up).* **Engaging in Argument from Evidence** Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-ETS1-2)** • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students evaluate proposed plans (Wrap Up).* **ETS1.A: Defining and Delimiting Engineering Problems** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. **(MS-ETS1-1)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.* • *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).* • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** All human activity draws on natural resources and has both short and long-term

submitting a wastewater solution proposal. • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a municipal waste water system (Part II, step 2).* • *Students use persuasive strategies to present a proposal to a panel of judges (Part II, steps 3 and 7).* • *Students evaluate proposed plans (Wrap Up).* **Constructing Explanations and Designing Solutions** Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.* • *Students describe how strain on a municipal wastewater system could affect the community and environment. 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Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).*	*wastewater collection system.* • *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students evaluate proposed plans (Wrap Up).* **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2)** • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students evaluate proposed plans (Wrap Up).*	consequences, positive as well as negative, for the health of people and the natural environment. **(MS-ETS1-1)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.* • *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).* • *Students describe how strain on a municipal wastewater system could affect the community and environment. 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Thus technology use varies from region to region and over time. **(MS- ESS3-3), (MS-ETS1-1)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.* • *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students describe how strain on a municipal wastewater system could affect the community and environment. 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NGSS Common Core Connections:
ELA/Literacy –
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2)
RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2)
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3),(MS-ETS1-1),(MS-ETS1-2)
WHST.6-8.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3),(MS-ETS1-1)
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
Mathematics –
MP.2 Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2)

Connections to other Common Core Standards at this Grade Level: RST.6-12.1; RST.6-12.2; SL.6-12.1; SL.6-12.4; SL.6-12.5; WHST.6-12.10

Correlation Comments	**Correlator Initials:** DBB

The issue and task at the core of Super Bowl Surge – the strain a community places on an aging wastewater collection and treatment system and developing a solution – aligns well with the core of the MS PEs MS- ESS3-3, MS-ETS1-1 and MS-ETS1-2, but the activity has weak to nonexistent correlations to the PE dimensions and none of the associated CCSS *as written.*

The suggested realignment of the activity outlined below and integration of the modifications in gray would provide a strong correlation to all three of the MS PEs and most of the connecting CCSS. The major key is adopting the modifications in gray regarding investigation of new technologies - and in particular for the higher grades, a developing a rubric of key criteria to assess the technology and/or conservation strategies that student groups may include in their plans. In accordance with NGSS practice, students need to be the drivers of developing the final rubric and I have included this as a task in the outline below – BUT, I highly suggest revising the existing student page 'Scope of Work' & 'RFP' pages to include a simple rubric to assess plans. This will further strengthen correlation to the 5th Grade PEs and will give Secondary students a starting point to revise and develop a more detailed rubric in accordance with grade level expectations.

The modifications in gray also have the added benefit of having students investigating the most current technologies for improving waster water collection systems. These modifications will also change the activity solution from the current focus on addressing concerns of different groups to a solution that will actually integrate the latest in wastewater collection technology and strategies.

In researching this correlation, I uncovered a lot of articles debunking the entire premise of this activity – and some were quite critical of those who perpetuate the myth, thus the reason for seeking permission (or writing our own version) of the Daily Beast article and adding an extension option that has students investigating the premise of this activity. Questioning the premise of information provided is the basis of one of the connecting CCSS – I debated whether to move this suggested Extension into the activity outline for the Secondary grades, but choose to leave it and let others decide its fate. ☺

Despite questions about the premise of the activity, I still suggest using it exactly as written currently – It does provide a great introduction and helps specify the community need students will address in the rest of the activity. However, it is suggested the Daily Beast article or a version of it be used as part of the Warm-up along with a simple diagram of how a municipal wastewater collection system works as a more rigorous, yet still engaging way to get students into the activity – I've included a link to one potential diagram below.

The Daily Beast article was very enlightening and does a wonderful job highlighting additional threats to a wastewater collection system that can easily be incorporated into the simulation by including a waste water collector bucket with overflow line and a bucket representing the city, treated water supply. If beads or water were used, students would dump the load from their house (yes, terminology intended) into the treatment plant bucket, then visit the city supply on the way back to their house to represent the water currently used to refill the toilets after flushing.

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Also included a suggestion to include a real or mock graph or data to create a graph for the City of Beaverton's system to meet the math CCSS. The activity already includes a suggestion that students request a copy of this graph for their local system, but there really should be one in the activity for them to view and analyze as well.

Warm-up –

- *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.*

Part I:

- *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).*
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Part III: ActionEducation

- *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* (*Secondary grade levels)*
- *Students develop a plan of action to reduce the demands on a municipal waste water system (Part II, step 2).*
- *Students use persuasive strategies to present a proposal to a panel of judges (Part II, steps 3 and 7).*
- *Students evaluate proposed plans (Wrap Up).*

Extension

- *Students research and develop an argument regarding the issue of the 'Super Bowl Surge.'*

Daily Beast article: *'The Super Bowl of Toilets'*: http://www.thedailybeast.com/articles/2015/01/31/the-super-bowl-of-toilets.html

Potential Diagram
http://capitalregionwater.com/wp-content/uploads/2014/10/CombineWasteWaterOverflow-1024x791.gif

Resources
Primer for Municipal Wastewater Treatment Systems
http://www.epa.gov/sites/production/files/2015-09/documents/primer.pdf

http://time.com/money/3689718/super-bowl-myths-hamburgers-flush-effect/

Project WET: Super Bowl Surge

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** Blue text represents the Extension section of the activity.*

Grade: HS	Ecosystems: Interactions, Energy, and Dynamics/ Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 405

Brief Lesson Description: Students learn how a stressed wastewater systems can be overwhelmed impact and then do in-depth research and present action plans to solve the problem of increased demands on a community's wastewater treatment plant.

Performance Expectation: HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

Performance Expectation: HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Constructing Explanations and Designing Solutions Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. **(HS-LS2-7)** Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. **(HS-ETS1-3)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.* • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students investigate and report on new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).*	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. **(HS-LS2-7)** • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students evaluate proposed plans (Wrap Up).* **LS4.D: Biodiversity and Humans** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. **(secondary to HS-LS2-7)** ***(Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)***	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. **(HS-LS2-7)** • *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.* • *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).* • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. **(HS-ETS1-3)** • *Students read "The Super Bowl of Toilets"*

	• *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students evaluate proposed plans (Wrap Up).* **ETS1.B: Developing Possible Solutions** When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. **(secondary to HS-LS2-7), (HS-ETS1-3)** • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students evaluate proposed plans (Wrap Up).*	*and review a diagram of a municipal wastewater collection system.* • *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)* • *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).* • *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.* • *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* • *Students develop a plan of action to reduce the demands on a treatment plant (Part II, step 2).* • *Students use persuasive strategies to present a proposal to a panel of judges (Part II, steps 3 and 7).* • *Students evaluate proposed plans (Wrap Up).*

NGSS Common Core Connections:

ELA/Literacy –

RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-LS2-7), (HS-ETS1-3)
RST.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-7)
RST.11-12.8.a–e	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-7),(HS-ETS1-3)
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-3)
WHST.9–12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS2-7)

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-LS2-7), (HS-ETS1-3)
MP.4	Model with mathematics. (HS-ETS1-3)

Connections to other Common Core Standards at this Grade Level: RST.6-12.1; RST.6-12.2; SL.6-12.1; SL.6-12.4; SL.6-12.5; WHST.6-12.10

Additional SEP Connections: Grades 9-12	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	• Ask questions
	  • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
	  • that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
	  • to determine relationships, including quantitative relationships, between independent and dependent variables.
	  • to clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
	• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3 , acre-feet, etc.)

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Scale, Proportion, and Quantity	Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Structure and Function	Students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
Stability and Change	Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments | **Correlator Initials:** DBB

The issue and task at the core of Super Bowl Surge – the strain a community places on an aging wastewater collection and treatment system and developing a solution – aligns well with the focus of the HS PEs HS-LS2-7 and (HS-ETS1-3), but the activity has weak to nonexistent correlations to the PE dimensions and none of the associated CCSS *as written.*

The suggested realignment of the activity outlined below and integration of the modifications in gray would provide a strong correlation to both HS PEs and most of the connecting CCSS. The major key is adopting the modifications in gray regarding investigation of new technologies - and in particular for the higher grades, developing a rubric of key criteria to assess the technology and/or conservation strategies that student groups may include in their plans. In accordance with NGSS practice, students need to be the drivers of developing the final rubric and I have included this as a task in the outline below – BUT, I highly suggest revising the existing student page 'Scope of Work' & 'RFP' pages to include a simple rubric to assess plans. This will further strengthen correlation to the 5th Grade PEs and will give Secondary students a starting point to revise and develop a more detailed rubric in accordance with grade level expectations.

The modifications in gray also have the added benefit of having students investigating the most current technologies for improving waster water collection systems. These modifications will also change the activity solution from the current focus on addressing concerns of different groups to a solution that will actually integrate the latest in wastewater collection technology and strategies.

In researching this correlation, I uncovered a lot of articles debunking the entire premise of this activity – and some were quite critical of those who perpetuate the myth, thus the reason for seeking permission (or writing our own version) of the Daily Beast article and adding an extension option that has students investigating the premise of this activity. Questioning the premise of information provided is the basis of one of the connecting CCSS – I debated whether to move this suggested Extension into the activity outline for the Secondary grades, but choose to leave it and let others decide its fate. ☺

Despite questions about the premise of the activity, I still suggest using it exactly as written currently – It does provide a great introduction and helps specify the community need students will address in the rest of the activity. However, it is suggested the Daily Beast article or a version of it be used as part of the Warm-up along with a simple diagram of how a municipal wastewater collection system works as a more rigorous, yet still engaging way to get students into the activity – I've included a link to one potential diagram below.

The Daily Beast article was very enlightening and does a wonderful job highlighting additional threats to a wastewater collection system that can easily be incorporated into the simulation by including a waste water collector bucket with overflow line and a bucket representing the city, treated water supply. If beads or water were used, students would dump the load from their house (yes, terminology intended) into the treatment plant bucket, then visit the city supply on the way back to their house to represent the water currently used to refill the toilets after flushing.

The activity suggests having students research the impact of low flow toilets on the wastewater collection system, but why not incorporate this into the research and development of their plans – and expanding it to also look at the impacts of – gray water diversion, treatment plant water needs, home water conservation technologies, etc. as well as new wastewater collection system technology/strategies?

Suggest including a real or mock graph or data to create a graph for the City of Beaverton's system to meet some of the math CCSS. The activity already includes a suggestion that students request a copy of this graph for their local system, but there really should be one in the activity for them to view and analyze as well. While inclusion of the graph does provide a weak correlation to the Math CCSS, it does not meet the level of rigor expected at the high school level.

Warm-up –

- *Students read "The Super Bowl of Toilets" and review a diagram of a municipal wastewater collection system.*

Part I:

- *Students simulate large event impact on a municipal wastewater system (Part I, steps 6 and 7).*
- *Students describe how strain on a municipal wastewater system could affect the community and environment. (Part I, step 8; Part II, step 2).*

Part II:

- *Students read "Treatment Plant Braces for 'Super Sunday' Surge" and review criteria for submitting a wastewater solution proposal.*
- *Students graph (or review a graph) of a sewage flow graph for the City of Beaverton.*
- *Students investigate new technologies to alleviate and improve city wastewater collection and treatment systems.*

- *Students investigate new technologies and conservation strategies that may impact city wastewater collection and treatment systems. (Extensions)*

Part III: ActionEducation

- *Students develop a rubric of criteria to assess each plan of action, including technology and strategies used to reduce the demands on a municipal waste water system.* (*Secondary grade levels)*
- *Students develop a plan of action to reduce the demands on a municipal waste water system (Part II, step 2).*
- *Students use persuasive strategies to present a proposal to a panel of judges (Part II, steps 3 and 7).*
- *Students evaluate proposed plans (Wrap Up).*

Extension

- *Students research and develop an argument regarding the issue of the 'Super Bowl Surge.'*

Daily Beast article: *'The Super Bowl of Toilets'*: http://www.thedailybeast.com/articles/2015/01/31/the-super-bowl-of-toilets.html

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Project WET: Super Sleuths

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<table>
<tr><td>Grade: MS</td><td>From Molecules to Organisms:
Structures and Processes</td><td>Project WET Guide, Page #:
Guide 2.0, p. 113</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students learn about the diversity of waterborne diseases and the role of epidemiology in disease control by searching for others who have been “infected” with the same waterborne disease that they have.</td></tr>
<tr><td colspan="3">Performance Expectation: MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.</td></tr>
<tr><td colspan="3">Performance Expectation: MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.</td></tr>
<tr><th>Science & Engineering Practice(s)</th><th>Disciplinary Core Idea(s)</th><th>Crosscutting Concept(s)</th></tr>
<tr><td>Planning and Carrying Out Investigations
Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.
Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and
progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)
• Students play a game in which they identify symptoms caused by microorganisms and match their symptoms with a partner. (Part I)
• Students conduct research to confirm their diseases and plot where these diseases may occur, worldwide. (Part II)</td><td>LS1.A: Structure and Function
All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)
• Students identify that microorganisms such as bacteria, viruses and protozoa make millions of children ill each year. (Warm Up)
• Students play a game in which they identify symptoms caused by microorganisms and match their symptoms with a partner. (Part I)
• Students conduct research to confirm their diseases and plot where these diseases may occur, worldwide. (Part II)

LS2.A: Interdependent Relationships in Ecosystems
Organisms, and populations of organisms, are dependent on
their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
• Students identify that microorganisms such as bacteria, viruses and protozoa make millions of children ill each year. (Warm Up)

In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
Growth of organisms and population increases are limited by access to resources. (MS-LS2-1).
• Students plot diseases on a world map and discuss conditions that might allow for the spread of diseases. (Step 4)</td><td>Scale, Proportion, and Quantity
Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)
• Students play a game in which they identify symptoms caused by microorganisms and match their symptoms with a partner. (Part I)

Interdependence of Science, Engineering, and Technology
Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)

Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)
• Students identify that microorganisms such as bacteria, viruses and protozoa make millions of children ill each year. (Warm Up)</td></tr>
</table>

NGSS Common Core Connections:
ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-2),(MS-LS2-4)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)

Mathematics –

Connections to other Common Core Standards at this Grade Level: RST.6-8.2, WHST.6-8.7 and RH.6-8.7

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings. Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation using models or representations. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.

Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Structure and Function	Structure and Function: Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Correlation Comments	**Correlator Initials:** ELC

Neither one of the PEs is a perfect match for this activity, although both do have parts that do apply, as indicated in gray.

No suggestions or discussion for this activity, except that the above NGSS is really about setting up an investigation and Super Sleuths is a game that provides much information about single-celled organisms and provides real world examples of how they might affect us. I don't necessarily think any tweaks or changes would make this any stronger, since the activity can stand alone and serve as an introduction to single-celled organisms.

Project WET: Super Sleuths

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Grade: HS	**Topic:**	**Project WET Guide, Page #:** Guide 2.0, p. 113
Brief Lesson Description: Students learn about the diversity of waterborne diseases and the role of epidemiology in disease control by searching for others who have been "infected" with the same waterborne disease that they have.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	NA	NA

NGSS Common Core Connections:

ELA/Literacy – NA

Mathematics – NA

Connections to other Common Core Standards at this Grade Level: RST.9-12.2, WHST.9-12.7

Additional SEP Connections: Grades 9-12	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions • that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Correlation Comments	**Correlator Initials:** ELC
No PEs for this activity at the HS level, but SEPs and CCCs for this one are listed above. Still a very useful activity for study of all disease-causing organisms and one-celled organisms.	

Project WET: The Long Haul

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 3-5		**Project WET Guide, Page #:** Guide 2.0, p. 273
Brief Lesson Description: Students work in teams to compete in a water-hauling game.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy –*** SL.3-5.1, SL.3-5.4 ***Mathematics –*** 3.MD.1, 4.MD.2		

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop and/or use models to describe and/or predict phenomena.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.

Correlation Comments	**Correlator Initials:** ELC

For all grades levels in this activity, the best matches to any NGSS PE stem from the second Extension activity, in which students consider firefighting techniques that are most efficient and then predict what firefighting might be like without current technology.

Otherwise, it is a good activity with social studies links to historical uses and availability of water. It is also a great outdoor activity for camp settings, summer school activities and day camps.

For Grades 3-5, The Long Haul could be a great lead in to the following NGSS PE:

3-5.ETS1-2: Generate and compare multiple, possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

The Long Haul could lead to this PE, for the Extension with only a bit of extra work in considering how well each idea meets the "the criteria and constraints" of developing the most efficient procedure.

Project WET: The Long Haul

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: K-2		Project WET Guide, Page #: Guide 2.0, p. 273
Brief Lesson Description: Students work in teams to compete in a water-hauling game.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy –*** SL.K-2.1, W.K-2.8 ***Mathematics –***		

Additional SEP Connections: Grades K-2	
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).

Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Use quantitative data to compare two alternative solutions to a problem.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Generate and/or compare multiple solutions to a problem

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.

Correlation Comments	**Correlator Initials:** ELC

For all grades levels in this activity, the best matches to any NGSS PE stem from the second Extension activity, in which students consider firefighting techniques that are most efficient and then predict what firefighting might be like without current technology.

Otherwise, it is a good activity with social studies links to historical uses and availability of water. It is also a great outdoor activity for camp settings, summer school activities and day camps.

For Grades K-2, The Long Haul could be a great lead in to the following NGSS PE:

K-LS1-1: Use observations to describe patterns of what plants and animals (including humans) need to survive.

K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

These are very different PEs, but The Long Haul could lead to each of them, with some work. Honestly, I'm even re-thinking my initial idea for K-ESS3-3 because the only link here would be for water conservation. I wouldn't think (as an educator/teacher) that I would want to talk about conserving water with K-2 kids. Even the older students will still talk about examples of water conservation that limit their own intake of water…that we can all conserve if we would all drink less water and that isn't the message that I would want to start kids thinking at this point…

Other ideas from those with more expertise in K-2 than I have? ☺

Project WET: The Long Haul

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Grade: MS		**Project WET Guide, Page #:** Guide 2.0, p. 273
Brief Lesson Description: Students work in teams to compete in a water-hauling game.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy –*** SL.6-8.1, SL.6-8.4 ***Mathematics –***		

Additional SEP Connections: Grades 6-8	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions • That can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation using models or representations.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.

Correlation Comments	**Correlator Initials:** ELC

For all grades levels in this activity, the best matches to any NGSS PE stem from the second Extension activity, in which students consider firefighting techniques that are most efficient and then predict what firefighting might be like without current technology.

Otherwise, it is a good activity with social studies links to historical uses and availability of water. It is also a great outdoor activity for camp settings, summer school activities and day camps.

For Grades 6-8, The Long Haul could be a great lead in to the following NGSS PE:

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

For both of these NGSS PEs, The Long Haul could be an introduction to these ideas—they are very different, but depending upon the focus, it could be taken in either direction.

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and natural environment that may limit possible solutions.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

The Long Haul could lead to all or some of these Engineering PEs, for the Extension about fire fighting. With MS-ETS1-1, it could also link up with MS-LS2-1, mentioned above. MS-ETS1-2 and MS-ETS1-3 are more similar with only a bit of extra work in considering how well each idea meets the "the criteria and constraints" of developing the most efficient procedure for the second Extension about fighting fire.

Project WET: The Long Haul

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** Blue text represents the Extension section of the activity.*

Grade: HS		**Project WET Guide, Page #:** Guide 2.0, p. 273
Brief Lesson Description: Students work in teams to compete in a water-hauling game.		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy –*** SL.9-12.1, SL.9-12.4 ***Mathematics –***		

Additional SEP Connections: Grades 9-12	
Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Correlation Comments	**Correlator Initials:** ELC

For all grades levels in this activity, the best matches to any NGSS PE stem from the second Extension activity, in which students consider firefighting techniques that are most efficient and then predict what firefighting might be like without current technology.

For Grades 9-12, The Long Haul could be a great lead in to the following NGSS PE:

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

The Long Haul could also apply to the above Science and Engineering Practices, but in all cases, matches up most closely with the second Extension activity. It would match even more closely with additional expectations for the Extension to follow the SEPs too such as adding in tradeoff considerations and ethical considerations.

Project WET: The Price is Right

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Grade: HS	**Earth and Human Activity**	**Project WET Guide, Page #:** Guide 2.0, p. 357
Brief Lesson Description: Students learn about economics and environmental planning as they calculate the cost of building a water development project.		
Performance Expectation: HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.		
Performance Expectation: HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*		
Performance Expectation: HS-EST1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.		
Performance Expectation: HS-EST1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). **(HS-ESS3-2)** • *Divide the class into small groups; supply each group with a copy of the Water Development System Map and review its contents and environmental features. Give each group a copy of the Student Data and Instruction Sheet and discuss it with the class. (Activity, Step 2)* • *Allow time for groups to identify what they think is the best location for each project. (Activity, Step 3)* • *Have each group present its proposed plan and calculated costs for class review. Group members should summarize considerations and factors they used to help them make the decision.* ***Encourage the class to provide constructive criticism for the proposed plans. Can the class reach consensus regarding where to locate the projects?*** *(Wrap Up)* **Constructing Explanations and**	**ESS3.A: Natural Resources** All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. **(HS-ESS3-2)** • *Explain to students that their task is to help a community redesign their municipal water supply and wastewater treatment systems…Both construction projects need to use Best Management Practices (BMPs); "best" can be defined as the route and location that entail the lowest costs and have fewer environmental effects.* ***Note: Real-life situations would involve many other considerations for choosing the best location, including health impacts, substrate conditions, aesthetics, political considerations and so forth.*** *(Activity, Step 1)* **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ***(secondary to HS-ESS3-2), (secondary HS-ESS3-4)*** • *To help students appreciate the costs involved in securing water resources, have students play a price guessing game. Students will guess the cost of a particular project chosen from the Water Project Cost Sampler in the sidebar. After their first guess, instruct them to guess higher or lower until they reach the*	……………………………………………………………… ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. **(HS-ESS3-2),(HS-ESS3-4)** Analysis of costs and benefits is a critical aspect of decisions about technology. **(HS-ESS3-2)** • *Divide the class into small groups; supply each group with a copy of the Water Development System Map and review its contents and environmental features. Give each group a copy of the Student Data and Instruction Sheet and discuss it with the class. (Activity, Step 2)* • *Allow time for groups to identify what they think is the best location for each project. (Activity, Step 3)* • *Inform students that in some situations, citizens must pay additional taxes to fund the construction of water management projects. How do they feel about citizens incurring the cost of the project through increased taxes? (Wrap Up)* • *Ask students if they think they would willingly pay higher taxes for more available water. Would they rather change their habits and use less water or pay more money for increased supplies? Discuss how the cost of water management projects is often a*

Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles and theories.

Design or refine a solution to a complex real-world problem based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations. **(HS-ESS3-4)**

- *Explain to students that their task is to help a community redesign their municipal water supply and wastewater treatment systems… Both construction projects need to use Best Management Practices (BMPs); "best" can be defined as the route and location that entail the lowest costs and have fewer environmental effects. Note: Real-life situations would involve many other considerations for choosing the best location, including health impacts, substrate conditions, aesthetics, political considerations and so forth. (Activity, Step 1)*
- *Present students with the Answer Key. Do students agree with the solutions given in the key? Tell students that if this were a real-life situation, other factors and conditions would come into play, and the actual locations might be different. In other words, students may have justifiable reasons why their proposals are better. (Wrap Up)*

Asking Questions and Defining Problems
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (**HS-EST1-1)**

- *Activity, Steps 1-3, Wrap Up*

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

Evaluate a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. **(HS-EST1-3)**

- *Have each group present its proposed plan correct price. (Warm Up)*
- *Explain to students that their task is to help a community redesign their municipal water supply and wastewater treatment systems…Both construction projects need to use Best Management Practices (BMPs); "best" can be defined as the route and location that entail the lowest costs and have fewer environmental effects.* ***Note: Real-life situations would involve many other considerations for choosing the best location, including health impacts, substrate conditions, aesthetics, political considerations and so forth.*** *(Activity, Step 1)*

ESS3.C: Human Impacts on Earth Systems
Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **(HS-ESS3-4)**

- *Both construction projects need to use Best Management Practices (BMPs); "best" can be defined as the route and location that entail the lowest costs and have fewer environmental effects. (Activity, Step 1) Discuss in depth the idea of Best Management Practices and how they are related to science/engineering. Discuss the idea of "Sum of the Parts" and human impact—small changes made by many people/places add up to large changes overall.*

ETS1.B: Developing Possible Solutions
When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary) **(HS-ESS3-4)**

- *Activity Steps 1-3, Wrap Up*

ETS1.A: Defining and Delimiting Engineering Problems
Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (**HS-EST1-1)**

- *Activity, Steps 1-3, Wrap Up*

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (**HS-EST1-1)**

- *Both construction projects need to use Best Management Practices (BMPs); "best" can be defined as the route and location that entail the lowest costs and have fewer environmental effects. (Activity, Step 1)*

prohibiting factor to building new systems. (Wrap Up)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2)
Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. **(HS-ESS3-2)**

Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. **(HS-ESS3-2)**

- *Present students with the Answer Key. Do students agree with the solutions given in the key? Tell students that if this were a real-life situation, other factors and conditions would come into play, and the actual locations might be different. In other words, students may have justifiable reasons why their proposals are better. (Wrap Up)*
- *Inform students that in some situations, citizens must pay additional taxes to fund the construction of water management projects. How do they feel about citizens incurring the cost of the project through increased taxes? (Wrap Up)*
- *Ask students if they think they would willingly pay higher taxes for more available water. Would they rather change their habits and use less water or pay more money for increased supplies? Discuss how the cost of water management projects is often a prohibiting factor to building new systems. (Wrap Up)*

Stability and Change
Feedback (negative or positive) can stabilize or destabilize a system. **(HS-ESS3-4)**

- *Although students discuss pros and cons related to various factors for each other's plans, as well as the answer key, the idea of feedback is not introduced. It could be introduced (using negative/positive feedback terminology) in relation to best practices and the long term outcome of using best practices vs. using other methods.*

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks **(HS-ESS3-4)**

- *This concept is addressed in the discussion of*

and calculated costs for class review. Group members should summarize considerations and factors they used to help them make the decision. Encourage the class to provide constructive criticism for the proposed plans. Can the class reach consensus regarding where to locate the projects? (Wrap Up) • *Present students with the Answer Key. Do students agree with the solutions given in the key? Tell students that if this were a real-life situation, other factors and conditions would come into play, and the actual locations might be different. In other words, students may have justifiable reasons why their proposals are better. (Wrap Up)*	*Discuss in depth the idea of Best Management Practices and how they are related to science/engineering. Discuss the idea of "Sum of the Parts" and human impact—small changes made by many people/places add up to large changes overall.* • *Have students learn about water projects in local communities. How much did they cost? Who paid for them? (Extension)* **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. **(HS-EST1-3)** • *Activity, Steps 1-3, Wrap Up*	*best practices (Activity, Step 1)—especially if emphasis is placed on how best practices are developed (progression in science/engineering). However, more emphasis could be placed on this concept, as well as a potential addition (extension) where students look at how something changes in the future (new road, larger population, etc.) and how the current proposal may need to be modified to take new growth/changes into account.* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.(**HS-EST1-1)** • *Activity, Steps 1-3, Wrap Up, study of previous and current wastewater technology may be appropriate* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. **(HS-EST1-3)** • *Activity, Steps 1-3, Wrap Up, study of previous and current wastewater technology may be appropriate*

NGSS Common Core Connections:

ELA/Literacy -

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ESS3-5)

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-2),(HS-ESS3-4)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6)

Project WET The Price is Right Common Core Correlations:

ELA: RST.9-12.3; RST.9-12.7; SL.9-12.1

Math: N-Q.1; A-CED.1

Additional SEP Connections:	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Ask questions • to clarify and refine a model, an explanation, or an engineering problem. • Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Additional Crosscutting Concepts by Grade Level	
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Correlation Comment	**Correlator Initials:** MJW
Post review comments: Reviewers had comments that standard HS-ESS3-2 was a weak correlation because it is more focused on energy and mineral resources than water, which is true. However, I think this activity *supports* HS-ESS3-2 because in the clarification statement it says "emphasis is on the conservation, recycling and reuse of resources (*such as* minerals and metals) where possible and on minimizing impacts where it is not. Water is a very closely related resource (solid water is considered a mineral). It also focuses on cost-benefit ratios which is a large theme in this activity. So, I recommend leaving this as a *supporting* correlation. Suggested additions: At one reviewer's suggestion I am adding HS-ETS1-1. I think this was not initially added because of the focus on a "major global challenge" which water treatment is, although this activity focuses on a local application. At the same reviewer's suggestion, I am also adding HS-ETS1-3, which is a good fit. Finally, at the second reviewer's suggestion I'm adding HS-ESS3-4, which is another good fit, although it does not necessarily address the cost/benefit piece of this activity explicitly.	

Project WET: The Pucker Effect

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extensions section of the activity.*

Grade: MS	Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, page 363

Brief Lesson Description: Students observe how ground water transports pollutants and simulate ground water testing to discover the source of contamination.

Performance Expectation: MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles to design an object, tool, process or system. • *Distribute Project Pucker Effect: Background, Procedures and Data Sheet. Have students complete the investigation and record their results. Each team should compare their results to the map made by the team that hid the contaminant. (Activity, Step 3)*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. • *This activity focuses on human impacts, but not the destruction of habitats/extinction. That focus could be added, but would detract from the message of the activity.* Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. • *No correlation.*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. • *The message of this activity is really cause and effect, not causation.* …………………………………………………………………… ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. • *The idea that point-source pollutants such as gas storage tanks can be found underground because that is historically where they were built is discussed in the background but not explicitly with the students.*

NGSS Common Core Connections:
Common Core State Standards Connections:
ELA/Literacy -

WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. *(MS-ESS3-3)*

Mathematics -

6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3), (MS-ESS3-4)
7.RP.A.2	Recognize and represent proportional relationships between quantities. (MS-ESS3-3), (MS-ESS3-4)
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-1), (MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5)

Additional SEP Connections:	
Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** MJW

I couldn't figure out where in the NGSS pH would be introduced. It appears to be outside the assessment boundaries for MS-PS1-2. However, it is not brought up specifically in HS, either. Assuming kids understand the concept of pH, MS-ESS3-3 is the best match (with changes geared toward the monitoring/minimizing impact method inclusion). 5-ESS3-1 could also fit, in theory, but kids would need to know about pH. HS-ESS3-4 is a potential match if the activity is reworked to include much more focus on a solution to the type of problem that is explored here.

After I started working to correlate this with MS-ESS3-3 I determined that it really does not align with that PE. Although it is the closest fit based on topic, the Science and Engineering Practice is much more geared toward developing methods for monitoring/minimizing impact rather than using tools/technology to learn about something not visible.

MS-ESS2-4 gets into some of the concepts here, too, but does not align with the main point of the activity.

Post Review Comments: After reading the reviewer comments and taking another read through the activity and looking at the MS standards I still think this is a tough fit for MS unless the student understand pH, which they likely don't in depth at this level. However, if they have a basic understanding of pH (and *why* it works as an indicator here), the method used in this activity is applicable. This is a guided inquiry, so students are carrying out (not planning) an investigation—although they do have some freedom in how they carry out the plan. I think this activity could support MS-ESS3-3 so I will go ahead and correlate that standard. I decided MS-ESS2-4 is too far off.

Project WET: The Pucker Effect

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: HS	Earth's Systems	Project WET Guide, Page #: Guide 2.0, page 363
Brief Lesson Description: Students observe how ground water transports pollutants and simulate ground water testing to discover the source of contamination.		
Performance Expectation: HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • *Activity and Wrap Up (conduct, not plan)*	**ESS2.C: The Roles of Water in Earth's Surface Processes** The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. • *More emphasis would need to be placed on the actual mechanism of transport of groundwater, but the idea that groundwater transports materials is inherent throughout the activity.*	**Structure and Function** The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. • *More emphasis would need to be placed on the actual mechanism of transport of groundwater.*
NGSS Common Core Connections: **ELA/Literacy** - WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-ESS2-5)		

Additional SEP Connections:	
Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Additional Crosscutting Concepts by Grade Level	
Patterns	Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.
Stability and Change	Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments	**Correlator Initials:** MJW

I couldn't figure out where in the NGSS pH would be introduced. It appears to be outside the assessment boundaries for MS-PS1-2. However, it is not brought up specifically in HS, either. Assuming kids understand the concept of pH, MS-ESS3-3 is the best match (with changes geared toward the monitoring/minimizing impact method inclusion). 5-ESS3-1 could also fit, in theory, but kids would need to know about pH. HS-ESS3-4 is a potential match if the activity is reworked to include much more focus on a solution to the type of problem that is explored here.

After I started working to correlate this with MS-ESS3-3 I determined that it really does not align with that PE. Although it is the closest fit based on topic, the Science and Engineering Practice is much more geared toward developing methods for monitoring/minimizing impact rather than using tools/technology to learn about something not visible.

MS-ESS2-4 gets into some of the concepts here, too, but does not align with the main point of the activity.

Post Review Comments: Although HS students are likely learning about pH, and that knowledge is necessary for this activity, the activity doesn't focus on pH so no correlations are made in the area of physical science. Other HS PE's taken into consideration include: HS-ESS2-2, HS-ESS2-5—both of these focus on natural processes, not human impacts. After consideration, I have decided to correlate to HS-ESS2-5, which this activity supports, although suggested changes would need to be made.

Erica suggested HS-ESS3-4 in grey. I've tied to align this but it just doesn't fit with the spirit of the activity despite the fact that the PE makes it sound like it should. It is too focused on engineering and refining the methods used to detect the pollution, not the spread of pollution by groundwater.

Project WET: The Thunderstorm

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: K	Weather and Climate	Project WET Guide, Page #: Guide 2.0, p. 209
Brief Lesson Description: Students simulate the sounds of a thunderstorm through physical activity and generate precipitation maps through a mock monitoring network.		
Performance Expectation: K-ESS2-1: Use and share observations of local weather conditions to describe patterns over time.		
Performance Expectation: K-ESS3-2: Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Asking Questions and Defining Problems Ask questions based on observations to find more information about the designed world. **(K-ESS3-2)** • *Students listen to a mock severe weather report and brainstorm actions they could take.* • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.* **Analyzing and Interpreting Data** Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. **(K-ESS2-1)** • *Students describe what a thunderstorm looks and sounds like. (Warm-up)* • *Students relate the sounds to actual thunderstorm events (Part I, step 2).* • *Students draw pictures and label progression of a thunderstorm. (Wrap-up)* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students listen to a mock severe weather report and brainstorm actions they could take.* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal*	**ESS2.D: Weather and Climate** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. **(K-ESS2-1)** • *Students describe what a thunderstorm looks and sounds like. (Warm-up)* • *Students relate the sounds to actual thunderstorm events (Part I, step 2).* • *Students draw pictures and label progression of a thunderstorm. (Wrap-up)* • *Students create a class image collection of thunderstorms. (Wrap-up)* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.* **ESS3.B: Natural Hazards** Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. **(K-ESS3-2)** • *Students describe what a thunderstorm looks and sounds like. (K-2 Warm Up)* • *Students draw pictures and label the stages of a thunderstorm. (Wrap-up)* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students listen to a mock severe weather report and brainstorm actions they could take.* • *Students develop a list of age/grade level*	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. **(K-ESS2-1)** • *Students describe what a thunderstorm looks and sounds like. (Warm-up)* • *Students relate the sounds to actual thunderstorm events (Part I, step 2).* • *Students draw pictures and label progression of a thunderstorm. (Wrap-up)* • *Students create a class image collection of thunderstorms. (Wrap-up)* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.* **Cause and Effect** Events have causes that generate observable patterns. **(K-ESS3-2)** • *Students describe what a thunderstorm looks and sounds like. (Warm-up)* • *Students relate the sounds to actual thunderstorm events (Part I, step 2).* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students draw pictures and label progression of a thunderstorm. (Wrap-up)* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.*

data by daily to annual time scales. **Obtaining, Evaluating, and Communicating Information** Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. **(K-ESS3-2)** • *Students describe what a thunderstorm looks and sounds like. (K-2 Warm Up)* • *Students simulate the sounds of a thunderstorm. (Part I, Step 1)* • *Students relate the sounds to actual thunderstorm events (Part I, step 2).* • *Students draw pictures and label the stages of a thunderstorm. (Wrap-up)* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students create a class image collection of thunderstorms. (Wrap-up)* • *Students listen to a mock severe weather report and brainstorm actions they could take.* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.* **Science Knowledge is Based on Empirical Evidence** Scientists look for patterns and order when making observations about the world. **(K-ESS2-1)** • *Students describe what a thunderstorm looks and sounds like. (K-2 Warm Up)* • *Students draw pictures and label progression of a thunderstorm. (Wrap-up)* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.*	*appropriate actions they can take to protect themselves in a thunderstorm.* • *Students are challenged to write a 'wild weather report' like the one prepared by the National Weather Service, but from the perspective of an animal or plant. (Extension)* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.*	.... ***Connections to Engineering, Technology, and Applications of Science*** ***Interdependence of Science, Engineering, and Technology*** *People encounter questions about the natural world every day.* ***(K-ESS3-2)*** • *Students describe what a thunderstorm looks and sounds like. (K-2 Warm Up)* • *Students draw pictures and label the stages of a thunderstorm. (Wrap-up)* • *Students develop a list and describe the observable signs of a thunderstorm that can be detected by their 5 senses. (Warm-up)* • *Students listen to a mock severe weather report and brainstorm actions they could take.* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.* ***Influence of Engineering, Technology, and Science on Society and the Natural World*** *People depend on various technologies in their lives; human life would be very different without technology.* **(K-ESS3-2)** • *Students listen to a mock severe weather report and brainstorm actions they could take.* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.*

NGSS Common Core Connections:
ELA/Literacy –

RI.K.1	With prompting and support, ask and answer questions about key details in a text. (K-ESS3-2)
W.K.7	Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-ESS2-1)
SL.K.3	Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (K-ESS2-1)
MP.4	Model with mathematics. (K-ESS2-1),(K-ESS3-2)
K.CC.1-3	Know number names and the count sequence. (K-ESS3-1),(K-ESS3-2)
K.CC.4-5	Count to tell the number of objects. (K-ESS3-1),(K-ESS3-2)
K.CC.6-7	Compare numbers. (K-ESS3-1),(K-ESS3-2)
K.MD.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-ESS2-1)
K.MD.3	Classify objects into given categories; count the number of objects in each category and sort the categories by count. (K-ESS2-1**)**

Connections to other Common Core Standards at this Grade Level: SL.K-8.1

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events).
Using mathematics and computational thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Decide when to use qualitative vs. quantitative data. • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Patterns: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
Cause and Effect	Cause and Effect: Students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.
Systems and System Models	Systems and System Models: Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Stability and Change	Stability and Change: Students observe some things stay the same while other things change, and things may change slowly or rapidly.

Correlation Comments	**Correlator Initials:** DBB
The existing K -2 Option of The Thunderstorm correlates well to Kindergarten NGSS Performance Expectations K-ESS2-1.and K-ESS3-2 *as written*, but *could* better align with each if modifications in grey are adopted and suggest inclusion of a simple Thunderstorm diagram and weather journal prompts in future guides or on the Portal. Based on correlation reviewer suggestions, suggest revising activity based on outline of components below. As with anything at this	

grade level, suggest running these modifications past those with ECE expertise on the P & P team and in network.

Warm-up: Describing a Phenomenon

- Students describe what a thunderstorm looks and sounds like. (Warm Up)

Part I: Simulating a Thunderstorm

- Students simulate the sounds of a thunderstorm. (Part I, Step 1)
- Students relate the sounds to actual thunderstorm events (Part I, step 2).
- Students draw pictures and label the stages of a thunderstorm. (Wrap-up)
- Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)
- Students create a class image collection of thunderstorms. (Wrap-up)

Part II: Thunderstorm Safety

- Students listen to a mock severe weather report and brainstorm actions they could take.
- Students estimate distances to mock lightning and thunder events. (Extension)
- Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.
- Students are challenged to write a 'wild weather report' like the one prepared by the National Weather Service, but from the perspective of an animal or plant. (Extension)

ActionEducation: Weather Monitoring

- Students create a daily storm journal to record number of sunny vs. stormy days and type of storm by daily to annual time scales.
- Students use grade appropriate math techniques to analyze their storm journal data.

Project WET: The Thunderstorm

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: 3	Weather and Climate	Project WET Guide, Page #: Guide 2.0, p. 209
Brief Lesson Description: Students simulate the sounds of a thunderstorm through physical activity and generate precipitation maps through a mock monitoring network.		
Performance Expectation: 3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.		
Performance Expectation: 3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data: Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. **(3-ESS2-1)** • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.* • *Students develop and interpret a rainfall map. (Part II, step 9 and Wrap Up).* • *Students analyze their monitoring network and develop a list of potential changes to improve network results. (Wrap Up).* • *Students simulate each change and compare map results.* • *Students record their rainfall data on the location of their home on a map of the community. (Wrap Up)* • *Students use data they gather to produce and interpret a local precipitation map. (Wrap Up)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* • *Students compare their precipitation maps to precipitation maps of the same area produced by local trusted sources. (Extension)* **Engaging in Argument from Evidence** Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. **(3-ESS3-1)** • *Students listen to a mock severe weather report and brainstorm actions they could take.*	**ESS2.D: Weather and Climate** Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. **(3-ESS2-1)** • *Students describe what a thunderstorm looks and sounds like. (Warm Up)* • *Students draw pictures and label the stages of a thunderstorm. (Wrap-up)* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students develop and interpret a rainfall map. (Part II, step 9 and Wrap Up).* • *Students discuss how precipitation maps can be used to predict and warn of hazards. (Part II, step 10, Extensions)* • *Students simulate each change and compare map results.* • *Students use data they gather to produce and interpret a local precipitation map. (Wrap Up)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* • *Students compare their precipitation maps to precipitation maps of the same area produced by local trusted sources. (Extension)* **ESS3.B: Natural Hazards** A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. **(3-ESS3-1)** • *Students describe what a thunderstorm looks and sounds like. (Warm Up)* • *Students listen to a mock severe weather*	**Patterns** Patterns of change can be used to make predictions. **(3-ESS2-1)** • *Students describe what a thunderstorm looks and sounds like. (Warm Up)* • *Students simulate the sounds of a thunderstorm. (Part I, Step 1)* • *Students relate the sounds to actual thunderstorm events (Part I, step 2).* • *Students draw pictures and label the stages of a thunderstorm. (Wrap-up)* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.* • *Students develop and interpret a rainfall map. (Part II, step 9 and Wrap Up).* • *Students discuss how precipitation maps can be used to predict and warn of hazards. (Part II, step 10, Extensions)* • *Students simulate each change and compare map results.* • *Students use data they gather to produce and interpret a local precipitation map. (Wrap Up)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* • *Students compare their precipitation maps to precipitation maps of the same area produced by local trusted sources. (Extension)* **Cause and Effect** Cause and effect relationships are routinely identified, tested, and used to explain change. **(3-ESS3-1)** • *Students relate the sounds to actual*

• *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students develop and interpret a rainfall map. (Part II, step 9 and Wrap Up).* • *Students discuss how precipitation maps can be used to predict and warn of hazards. (Part II, step 10, Extensions)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results. (Wrap Up).* • *Students use data they gather to produce and interpret a local precipitation map. (Wrap Up)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* • *Students compare their precipitation maps to precipitation maps of the same area produced by local trusted sources. (Extension)*	*report and brainstorm actions they could take.* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students simulate a thunderstorm rainfall event. (Part II, Step 3)* • *Students discuss how precipitation maps can be used to predict and warn of hazards. (Part II, step 10, Extensions)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results. (Wrap Up).* • *Students simulate each change and compare map results.* • *Students use data they gather to produce and interpret a local precipitation map. (Wrap Up)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* • *Students compare their precipitation maps to precipitation maps of the same area produced by local trusted sources. (Extension)*	*thunderstorm events (Part I, step 2).* • *Students draw pictures and label the stages of a thunderstorm. (Wrap-up)* • *Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)* • *Students estimate distances to mock lightning and thunder events. (Extension)* • *Students develop and interpret a rainfall map. (Part II, step 9 and Wrap Up).* • *Students discuss how precipitation maps can be used to predict and warn of hazards. (Part II, step 10, Extensions)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results. (Wrap Up).* • *Students simulate each change and compare map results.* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). **(3-ESS3-1)** • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students discuss how precipitation maps can be used to predict and warn of hazards. (Part II, step 10, Extensions)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results. (Wrap Up).* • *Students simulate each change and compare map results.* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* .... ***Connections to Nature of Science*** **Science is a Human Endeavor** Science affects everyday life**. (3-ESS3-1)** • *Students listen to a mock severe weather report and brainstorm actions they could take.* • *Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.* • *Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.* • *Students simulate a thunderstorm rainfall event. (Part II, Step 3)*

		• *Students develop and interpret a rainfall map. (Part II, step 9 and Wrap Up).* • *Students analyze their monitoring network and develop a list of potential changes to improve network results. (Wrap Up).* • *Students simulate each change and compare map results.* • *Students use data they gather to produce and interpret a local precipitation map. (Wrap Up)* • *Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.* • *Students compare their precipitation maps to precipitation maps of the same area produced by local trusted sources. (Extension)*

NGSS Common Core Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-ESS3-1)

W.3.1.a–d Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESS3-1)

W.3.7 Conduct short research projects that build knowledge about a topic. (3-ESS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (3-ESS2-1), (3-ESS3-1)

MP.4 Model with mathematics. (3-ESS2-1), (3-ESS3-1)

MP.5 Use appropriate tools strategically. (3-ESS2-1)

3.MD.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-ESS2-1)

3.MD.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. (3-ESS2-1)

Connections to other Common Core Standards at this Grade Level: SL.3.1; 3.NF.1;

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.

Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Using mathematics and computational thinking	Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Scale, Proportion, and Quantity	Scale, Proportion, and Quantity: Students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.
Systems and System Models	Systems and System Models: Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Stability and Change	Stability and Change: Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	**Correlator Initials:** DBB

The Thunderstorm correlates well to the 3rd Grade NGSS Performance Expectations 3-ESS2-1 and 3-ESS3-1 *as written*, but *could* better align with each AND correlate if modifications in grey are adopted and suggest inclusion of a simple Thunderstorm diagram and weather journal prompts in future guides or on the Portal.

Based on correlation reviewer suggestions, suggest revising activity based on outline of components below.

Warm-up: Describing a Phenomenon

- Students describe what a thunderstorm looks and sounds like. (Warm Up)

Part I: Simulating a Thunderstorm

- Students simulate the sounds of a thunderstorm. (Part I, Step 1)
- Students relate the sounds to actual thunderstorm events (Part I, step 2).
- Students draw pictures and label the stages of a thunderstorm. (Wrap-up)
- Students describe the observable signs of a thunderstorm based on their 5 senses. (Warm-up)

Part II: Thunderstorm Safety

- Students listen to a mock severe weather report and brainstorm actions they could take.
- Students estimate distances to mock lightning and thunder events. (Extension)
- Students develop a list of age/grade level appropriate actions they can take to protect themselves in a thunderstorm.

ActionEducation: Weather Monitoring

- Students create a daily storm journal to record number of sunny vs. stormy days and type of storm.
- Students use grade appropriate math techniques to analyze their storm journal data by daily to annual time scales.

Part III: Precipitation Mapping

- Students simulate a thunderstorm rainfall event. (Part II, Step 3)
- Students develop and interpret a rainfall map. (Part II, step 9 and Wrap Up).
- Students discuss how precipitation maps can be used to predict and warn of hazards. (Part II, step 10, Extensions)
- Students analyze their monitoring network and develop a list of potential changes to improve network results. (Wrap Up).
- Students repeat thunderstorm rainfall event with each change and compare map results.

ActionEducation: Precipitation Monitoring

- Students measure the amount of rain collected at their home in the next storm. (Wrap Up)
- Students record their rainfall data on the location of their home on a map of the community. (Wrap Up)
- Students use data they gather to produce and interpret a local precipitation map. (Wrap Up)
- Students analyze their monitoring network and develop a list of potential changes to improve network results to better detect precipitation events in the community.
- Students compare their precipitation maps to precipitation maps of the same area produced by local trusted sources. (Extension)
- Students become active members of CoCoRAHS or similar weather monitoring network.

Project WET: There is No Away: Pre K-2 Activity

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: K	Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 453
Brief Lesson Description: Every day each of us generates trash. By looking more closely at what we are throwing away and calculating the rate of recycling, students discover not only how much garbage is produced, but also how much of it can be reused, recycled or composted. When they reuse, recycle, compost or dispose of their trash properly, individuals take control of their trash and help keep litter out of our waterways and ocean basins.		
Performance Expectation: K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Obtaining, Evaluating, and Communicating Information Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. **(K-ESS3-3)** • *Have them look at the grocery shelves and draw a line from an item on the shelf to the basket in which it belongs. Each container is either made of plastic, paper, aluminum, steel or tin or glass. (Warm Up)* • *Ask students to identify if their item is recyclable, reusable, compost or trash (throw away, place in trash can). Ask them if items can be both reusable and recyclable. Why or why not? (Step 3)* • *One at a time, ask each student what he or she would like to do with the item: recycle it, reuse it, compost it or throw it away? Have students place their items in piles labeled reuse, recycle, compost and trash. (Activity, Step 4)*	**ESS3.C: Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. **(K-ESS3-3)** • *Have them look at the grocery shelves and draw a line from an item on the shelf to the basket in which it belongs. Each container is either made of plastic, paper, aluminum, steel or tin or glass. (Warm Up)* • *One at a time, ask each student what he or she would like to do with the item: recycle it, reuse it, compost it or throw it away? Have students place their items in piles labeled reuse, recycle, compost and trash. (Step 4)* • *Discuss how reusing, recycling and composting prevent trash from ending up in the landfill. Remind students that the most important part of dealing with trash is that it be disposed of properly (i.e., no littering). (Wrap Up)* **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. ***(secondary to K-ESS3-3)*** • *If the student has an idea to reuse their item, have them sketch that idea on paper and share with the group. (Step 4)*	**Cause and Effect** Events have causes that generate observable patterns. **(K-ESS3-2), (K-ESS3-3)** • *Discuss how reusing, recycling and composting prevent trash from ending up in the landfill. (Wrap Up)*
NGSS Common Core Connections: ***ELA/Literacy –*** **SL.K.5** Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1) **Connections to other Common Core Standards at this Grade Level:** ***ELA***: R.K-2.3; RI.6-8.5; RI.2.6; RI.6-12.6; RI.3-6.7; RI.8.7; RI.K-1.9; RST.6-12.3; W.3-12.7; W.3-4.8; WHST.6-8.6; WHST.6-12.7 ***Math***: K.MD.2; K.MD.3; 5.MD.5b; 6.NS.3; 6.RP.3c; 7.RP.3		

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Define a simple problem that can be solved through the development of a new or improved object or tool.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. • Generate and/or compare multiple solutions to a problem

Additional Crosscutting Concepts by Grade Level K-2	
Structure and Function	Students observe the shape and stability of structures of natural and designed objects are related to their function(s).

Correlation Comments	**Correlator Initials:** MJW
Possible alignments *K-ESSE-3** *5-ESSE-1** *MS-ESS3-3** *HS-ESS3-4—Although this activity does not fit this PE, this activity could serve as support or a starting point for a research project where students evaluate recycling systems in their school, community and/or country, research recycling technology and systems in other places and report back to evaluate/refine the system(s) they are comparing*	

Project WET: There is No Away

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 453
Brief Lesson Description: Every day each of us generates trash. By looking more closely at what we are throwing away and calculating the rate of recycling, students discover not only how much garbage is produced, but also how much of it can be reused, recycled or composted. When they reuse, recycle, compost or dispose of their trash properly, individuals take control of their trash and help keep litter out of our waterways and ocean basins.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles to design an object, tool, process or system. **(MS-ESS3-3)** • While potentially opportunities for students to "apply scientific principles to design and object, *tool, process or system" the following bullets as written in the activity are not strong in this area. To really address this SEP focus on extensions, or modify emphasis of Part II and III to focus more directly the scientific principles related to recycling that are involved in the creation of the object the student creates.* • *Discuss with the class their findings. Are there additional things that could be done at the school to reduce the total quantity of garbage headed for landfills? (Ideas may include composting, additional recycling efforts for more items or educational outreach at the school.) What are the opportunities and challenges involved in reducing landfill trash at school? Are they the same as the opportunities and challenges faced at home? (Activity, Part I, Step 5)* • *Ask students to create their own slogan for their product that encourages reuse. Students may draw and color or use a computer program to design an ad that promotes their product and includes the product's slogan. (Activity, Part II, Step 4)* • *Have students share the ads and products with the class. (Activity, Part II, Step 5)* • *Divide students into teams of two or more and give each team the Student Copy Page—*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Prior to beginning the Warm Up, discuss with students how excess waste is a problem and how recycling can conserve resources.* • *Share with students the Take Control of Your Trash! illustration comparison and discussion. Were they surprised by the amount of paper in our trash? Review the items that can be recycled in your school and/or community and the best method for recycling materials. (Warm Up)* • *Provide to students the dimensions of the school's garbage and recycling containers or visit the site and ask students to use the tape measure to measure the containers themselves. Ask them to note the fullness of each container (i.e., 60 percent full). (Activity, Part I, Step 3)* • *Ask students to complete the Student Copy Page—Rate of Recycling to calculate the rate of recycling for their school. (Activity, Part I, Step 4)* • *Discuss with the class their findings. (Activity, Part I, Step 5)* • *Hand out the Student Copy Page— Litter and Water Don't Mix. Ask students to compare the two photographs. Ask them if the condition of the littered beach is preventable. How? As they examine the items on the beach, have them indicate what could have been reused, recycled or composted. What should have been done with the remaining items? (Activity, Part III, Step 2)* • *Ask students whose responsibility it is to prevent waterways from becoming waste*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *Ask students if they can recall other PSAs (public service announcements) that have made a difference in our society. (Activity, Part III, Step 6)* • *Discuss with students how advertising influences individual attitudes and actions, such as littering or recycling. Ask them if we currently have a solution to littered waterways and beaches, for example. (Each individual taking responsibility for his or her trash.) (Wrap Up)* .... ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-2), (MS-ESS3-3)**

Recycled Words. Ask them to think about what they have learned about protecting our waterways from litter and our ability and will to reuse, recycle, compost or trash it. Have them develop public service advertising campaigns and a slogan. (Activity, Part III, Step 7) • *Have groups share their campaign ideas and slogans with the class. Using the questions on the Student Copy Page—Recycled Words as a guide, have the class select a favorite and implement the campaign. (Activity, Part III, Step 8)* • *Have students organize a Reuse/Exchange Fair in their classroom or school. Students can create items for the fair (e.g., bird feeders from milk jugs, pencil holders from cans, flour/sugar canisters from coffee cans). Students may also take this opportunity to educate their community about the importance of reusing and recycling. (Action Education™)* • *Have students examine the innovative ways that trash is being removed from waterways. Internet or library research can uncover some of the newest ideas in removal. (Extension)* • *Have students experiment with creating methods and tools for capturing debris and trash in waterways. (Extension)* • *What ideas can students offer for cleaning the Garbage Patch in the Pacific Ocean? Have them research the Internet and other sources to see what is being proposed. (Extension)*	*ways. (Activity, Part III, Step 3)* • *Discuss with the class the implications of neglecting efforts to recycle. Ask them to identify why recycling is a valuable activity and the ways in which they can recycle and reuse items. Discuss why it is important to quantify recycling and waste. (What we measure we can generally improve.) (Wrap Up)* Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **(MS-ESS3-3), (MS-ESS3-4)** • *Discuss rates of waste production vs. recycling rates. Discuss the importance and impacts of recycling.* • *Have students examine the innovative ways that trash is being removed from waterways. Internet or library research can uncover some of the newest ideas in removal. (Extension)* • *Have students experiment with creating methods and tools for capturing debris and trash in waterways. (Extension)* • *What ideas can students offer for cleaning the Garbage Patch in the Pacific Ocean? Have them research the Internet and other sources to see what is being proposed. (Extension)* • *Have students organize a Reuse/Exchange Fair in their classroom or school. Students can create items for the fair (e.g., bird feeders from milk jugs, pencil holders from cans, flour/sugar canisters from coffee cans). Students may also take this opportunity to educate their community about the importance of reusing and recycling. (Action Education™)*	

NGSS Common Core Connections:
ELA/Literacy -
Mathematics -
MP.2 Reason abstractly and quantitatively. (MS-ESS3-2),(MS-ESS3-5)
7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-ESS3-3),(MS-ESS3-4)

Project WET Common Core Correlations for There is No Away:
ELA: R.K-2.3; RI.6-8.5; RI.2.6; RI.6-12.6; RI.3-6.7; RI.8.7; RI.K-1.9; RST.6-12.3; W.3-12.7; W.3-4.8; WHST.6-8.6; WHST.6-12.7
Math: K.MD.2; K.MD.3; 5.MD.5b; 6.NS.3; 6.RP.3c; 7.RP.3

Additional SEP Connections:	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Ask questions • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • that require sufficient and appropriate empirical evidence to answer. • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. • that challenge the premise(s) of an argument or the interpretation of a data set.
Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena.
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Correlation Comments	**Correlator Initials:** MJW
Possible alignments *K-ESSE-3** *5-ESSE-1** *MS-ESS3-3** *HS-ESS3-4—Although this activity does not fit this PE, this activity could serve as support or a starting point for a research project where students evaluate recycling systems in their school, community and/or country, research recycling technology and systems in other places and report back to evaluate/refine the system(s) they are comparing.*	

Project WET: Urban Waters

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: 5</td><td>Earth and Human Activity</td><td>Project WET Guide, Page #:
Guide 2.0, p. 413</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students learn about different water resource occupations and place them in a sequence, from source water to delivery into homes, focusing on water's use, treatment and return to the source. Some people call this the urban water cycle.</td></tr>
<tr><td colspan="3">Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</td></tr>
<tr><td>Science & Engineering Practice(s)</td><td>Disciplinary Core Idea(s)</td><td>Crosscutting Concept(s)</td></tr>
<tr><td>Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)
• Introduce students to The Urban Water Cycle diagram, discuss each of the following parts and play The Urban Water Cycle Game as a fun and educational option: (Warm Up)
• Ask students to list the different professions of the people involved in getting water through the urban water cycle. The list is large, and students should be encouraged to add to it. (Warm Up) have students use more than one media source to do this (i'e, webpage, books, you tube job shadow and/or the interview suggested in extension.
• Divide the class into small groups and give each group a set of shuffled Water Career Cards. Ask each group to arrange the cards in what they think is the best order. (Activity, Step 2)
• Ask each group to explain the water career pathways and relationships they have devised. Have groups compare their arrangements, discussing whether or not the town of Heretothere will get its water. (Activity, Step 3)
• Present students with the order given on the original Water Career Cards sheet. Ask students to evaluate their own sequencing and make adjustments. (Activity, Step 4)
• Remind students of the variety of careers related to water other than water supply (Activity, Step 5)
• Ask students to create a wall-sized mural of water on its pathways. Include drawings of people of different professions working in</td><td>ESS3.C: Human Impacts on Earth Systems
Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)
• Greater focus on connecting the jobs with their role in maintaining or safeguarding the urban water cycle.
• Introduce students to The Urban Water Cycle diagram, discuss each of the following parts and play The Urban Water Cycle Game as a fun and educational option: (Warm Up)
• Ask students to list the different professions of the people involved in getting water through the urban water cycle. The list is large, and students should be encouraged to add to it. (Warm Up)
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• Remind students of the variety of careers related to water other than water supply (Activity, Step 5)
• Ask students to create a wall-sized mural of water on its pathways. Include drawings of people of different professions working in appropriate settings and with appropriate equipment (i.e., a chemist located near the water treatment plant). (Wrap Up)</td><td>Systems and System Models
A system can be described in terms of its components and their interactions. (5-ESS3-1)
• Introduce students to The Urban Water Cycle diagram, discuss each of the following parts and play The Urban Water Cycle Game as a fun and educational option: (Warm Up)
• Ask students to create a wall-sized mural of water on its pathways. Include drawings of people of different professions working in appropriate settings and with appropriate equipment (i.e., a chemist located near the water treatment plant). (Wrap Up)
• Have students brainstorm what they think are parts of the urban water cycle - or give them the title for each of the 8 -steps in the game - and have them put together how the parts connect.
• Greater focus on connecting the jobs with their role in maintaining or safeguarding the urban water cycle.
....
Connections to Nature of Science

Science Addresses Questions About the Natural and Material World.
Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)
• Instruct students to select one or more water-related careers they would like to know more about. They should contact a water professional and ask to interview him or her about a typical day at work. (Wrap Up)
• Invite water-related professionals to explain their roles in water management to the class and discuss the nature and significance of their jobs with students (Extension)
• Have students develop and investigate questions (questions that can be answered with empirical evidence) about the role of different urban water cycle jobs.</td></tr>
</table>

appropriate settings and with appropriate equipment (i.e., a chemist located near the water treatment plant). (Wrap Up) • *Instruct students to select one or more water-related careers they would like to know more about. They should contact a water professional and ask to interview him or her about a typical day at work. (Wrap Up)* • *Have each student write an advertisement for a career in water. Review your local paper for examples of job advertisements. Post the advertisements for the students to review and then ask them to create a résumé for the job that is most suited their interests. (Wrap Up)* • *Invite water-related professionals to explain their roles in water management to the class and discuss the nature and significance of their jobs with students. (Extension)*	• *Instruct students to select one or more water-related careers they would like to know more about. They should contact a water professional and ask to interview him or her about a typical day at work. (Wrap Up)* • *Have each student write an advertisement for a career in water. Review your local paper for examples of job advertisements. Post the advertisements for the students to review and then ask them to create a résumé for the job that is most suited their interests. (Wrap Up)* • *Invite water-related professionals to explain their roles in water management to the class and discuss the nature and significance of their jobs with students (Extension)*	

NGSS Common Core Connections:

Connections to other Common Core Standards at this Grade Level:
ELA: RST.6-12.4; WHST.6-12.10

Additional SEP Connections:	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.

Correlation Comments	**Correlator Initials:** MJW

Possible alignments

2-ESS2
*5-ESS3-1**
MS-ESS2-4: Although relating to the water cycle, this standard is not a good fit because its focus is on mechanisms of state change as it moves through the water cycle (The Incredible Journey is a perfect fit).

MS-ESS3—this set of Performance Expectations is close in content area, but geared more toward design and impact on the environment when this activity is focused on process and the career roles involved.

*HS-ESS3-4**
HS-ETS1-1?

Post Review Comments: Made changes to gray areas according to Brian's comments below. Kept the PE but it fits better now. This activity needs these suggested changes to correlate!

From Brian: REVISIT - Agree with Reviewer on SEP and DCI, but with Molly on the PE to connect. Suggest inserting gray landuage to have students brainstorm what they think are parts of the urban water cycle - or give them the title for each of the 8 -steps in the game - and have them put together how the parts connect. Also suggest greater focus on connecting the jobs with their role in maintaining or safegaurding the urban water cycle - and having students develop questions about the role of those jobs to investigate - i.e., questions that can be answered with empirical evidence. Gray language should also be included to have students use more than one media source to do this (i'e, webpage, books, you tube job shadow and/or the interview suggested in activity. This would meet the intent of the SEP and directly address the DCI and Nature of Science component - and in the process would be cross-verifying what is in the activity with the job in real-life.

Project WET: Virtual Water

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

<table>
<tr><td>Grade: 5</td><td>Topic: Earth and Human Activity</td><td>Page #: Guide 2.0, p. 289</td></tr>
<tr><td colspan="3">Brief Lesson Description: Students create a “water web” to illustrate their dependence on water and the interdependence among water users, producers and people worldwide.</td></tr>
<tr><td colspan="3">Performance Expectation: 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.</td></tr>
<tr><th>Science & Engineering Practice(s)</th><th>Disciplinary Core Idea(s)</th><th>Crosscutting Concept(s)</th></tr>
<tr><td>Obtaining, Evaluating and Communicating Information
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)
• Students may research how their water user depends on this resource. (The Activity, Step 1)
• Ask a representative to explain how the group uses water and what they grow, manufacture or produce. Ask other students to raise their hands if they use the goods or services offered by that group. (The Activity, Step 3)
• Discuss the results of the activity. Have students create a diagram displaying how water users depend upon the goods and services provided by other water users near and far. (Wrap Up)</td><td>ESS3.C: Human Impacts on Earth Systems
Human activities in agriculture, industry and everyday life have had major effects on land, vegetation, streams, oceans, air and even outer space. But individuals and communities are doing things to help protect Earth’s resources and environments. (5-ESS3-1)
• Have all the groups repeat the process until connections are made among all or most class members. There is a good chance that some food products, such as bread, cereal or potatoes, may be consumed by all students, and in this situation, thread the string/yarn to all students in the circle. This will reinforce the universal importance of these items. (The Activity, Step 6)
• To emphasize the interdependencies among water users, have one student tug gently on the string. Ask those who felt the pull to raise their hands. The tug symbolizes reliance on both water and that student’s product. (The Activity, Step 7)
• Tell students a bottle of food coloring represents a source of pollution. Place a drop in the jug. Have students explain how water quality affects the quantity of water available to water users. (Extension)</td><td>Systems and System Models
A system can be described in terms of its components and their interactions. (5-ESS3-1)
• Have all the groups repeat the process until connections are made among all or most class members. There is a good chance that some food products, such as bread, cereal or potatoes, may be consumed by all students, and in this situation, thread the string/yarn to all students in the circle. This will reinforce the universal importance of these items. (The Activity, Step 6)
• To emphasize the interdependencies among water users, have one student tug gently on the string. Ask those who felt the pull to raise their hands. The tug symbolizes reliance on both water and that student’s product. (The Activity, Step 7)
....
Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
• Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)</td></tr>
<tr><td colspan="3">NGSS Common Core Connections:

Connections to other Common Core Standards at this Grade Level: RI.3.7; RI.4.7; RI.6.7; RI.11-12.7; RST.6-12.3; RST.6-8.7; SL.3.2; SL.5.2; SL.6.2</td></tr>
</table>

Additional SEP Connections	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts Connections	
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	**Correlator Initials:** MJW
Possible NGSS connections: 2-LS2-1 4-ESS3-1 5-LS1-1 5-LS2-1 5-ESS3-1* MS-LS2-1* MS-LS2-3 MS-LS2-4 MS-ESS3-1 MS-ESS3-4	

Project WET: Water Address

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity*

Grade: Kindergarten	**From Molecules to Organisms: Structures and Processes**	**Project WET Guide, Page #:** Guide 1.0, Portal
Brief Lesson Description: Students identify plants and animals and their habitats by analyzing clues that describe water-related adaptations of aquatic and terrestrial organisms.		
Performance Expectation: K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.		
Performance Expectation: K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. **(K-LS1-1)** • *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.* • *Students discuss and record how plants and animals use and/or live in water based on evidence observed in pictures. (K-2 Option)* • *Students* identify *special features of plants and animals* that help them live in their environment *based on evidence observed in pictures. (K-2 Option)* • *Students compete in an activity, using evidence in picture fragments, to be the first to identify a plant or animal. (K-2 Option)* • *Students draw and describe special features of plants and animals* that help them live in their environment *based on evidence observed in pictures. (K-2 Option)* • *Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special features that helps the plant or animal survive.* **Developing and Using Models** Use a model to represent relationships in the natural world. **(K-ESS3-1)** • *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.* • *Students compete in an activity, using evidence in picture fragments, to be the first to identify a plant or animal. (K-2 Option)* • *Students draw and describe special features of plants and animals* that help them live in their environment *based on evidence*	**ESS3.A: Natural Resources** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. **(K-ESS3-1)** • *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.* • *Students discuss and record how plants and animals use and/or live in water based on evidence observed in pictures. (K-2 Option)* • *Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special features that helps the plant or animal survive.* **LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. **(K-LS1-1)** • *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.* • *Students discuss and record how plants and animals use and/or live in water based on evidence observed in pictures. (K-2 Option)* • *Students* identify *special features of plants and animals* that help them live in their environment *based on evidence observed in pictures. (K-2 Option)*	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. **(K-LS1-1)** • *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.* • *Students discuss and record how plants and animals use and/or live in water based on evidence observed in pictures. (K-2 Option)* • *Students compete in an activity, using evidence in picture fragments, to be the first to identify a plant or animal. (K-2 Option)* • *Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special features that helps the plant or animal survive.* **Systems and System Models** Systems in the natural and designed world have parts that work together. **(K-ESS3-1)** • *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.* • *Students* identify *special features of plants and animals* that help them live in their environment *based on evidence observed in pictures. (K-2 Option)* • *Students draw and describe special features of plants and animals* that help them live in their environment *based on evidence observed in pictures. (K-2 Option)* • *Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special*

observed in pictures. (K-2 Option) • Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special features that helps the plant or animal survive. .... ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** Scientists look for patterns and order when making observations about the world. **(K-LS1-1)** • *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.* • *Students discuss and record how plants and animals use and/or live in water based on evidence observed in pictures. (K-2 Option)* • *Students compete in an activity, using evidence in picture fragments, to be the first to identify a plant or animal. (K-2 Option)* • *Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special features that helps the plant or animal survive.*	• *Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special features that helps the plant or animal survive.*	*features that helps the plant or animal survive.*

NGSS Common Core Connections:
ELA/Literacy –

SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1)
W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-LS1-1)

Additional SEP Connections: Grades K-2	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation.
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). • Develop a simple model based on evidence to represent a proposed object or tool.

Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make predictions based on prior experiences.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events). • Analyze data from tests of an object or tool to determine if it works as intended.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
Engaging in argument from evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
Patterns	Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Systems and System Models	Students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.
Structure and Function	Students observe the shape and stability of structures of natural and designed objects are related to their function(s).

Correlation Comments	**Correlator Initials:** DBB

Water Address correlates well to the Kindergarten NGSS Performance Expectation K-LS1-1 *as written,* but *does not* correlate well to the CCSS tied to this PE. However, re-aligning the activity to enhancing and/or highlighting student actions already in the K-2 Option of the activity will help correlate the activity to the Language Arts CCSS – and will correlate the activity to PE K-ESS3-1.

Highly suggest images of every organism in the 'Water Address' activity are found *with* evidence of their basic needs in the picture for teachers to easily find and use. Could be a Portal team project, unless copyright permission is needed for the images.

The activity does not include Math – It *looks* like it may be easy to include, but highly suggest asking Coordinators with ECE expertise to review and suggest grade appropriate enhancements to address the CCSS Math.

K-2 Option

Warm-up: Ecosystem & Organism Features

- *Students discuss and record how plants and animals use and/or live in water based on evidence observed in pictures. (K-2 Option)*
- *Students identify what a plant or animal needs to survive in it environment by circling, drawing lines or in other manner connecting the organism to needs in a picture.*

Part I: Connecting Adaptations & the Environment

- *Students* identify *special features of plants and animals* that help them live in their environment *based on evidence observed in pictures. (K-2 Option)*
- *Students draw and describe special features of plants and animals* that help them live in their environment *based on evidence observed in pictures. (K-2 Option)*

Part II: Understanding Ecosystem Relationships

- *Students compete in an activity, using evidence in picture fragments, to be the first to identify a plant or animal. (K-2 Option)*

Part III: ActionEducation:

- *Students observe a plant or animal at home or at school and describe what it needs to survive, how it gets and uses water. Students include a drawing that shows special features that helps the plant or animal survive.*

Project WET: Water Address

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 3	Heredity: Inheritance and Variation of Traits/ Biological Evolution: Unity and Diversity/ Earth's Systems	Project WET Guide, Page #: Guide 1.0, Portal

Brief Lesson Description: Students identify plants and animals and their habitats by analyzing clues that describe water-related adaptations of aquatic and terrestrial organisms.

Performance Expectation: 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.

Performance Expectation: 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

Performance Expectation: 3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Engaging in Argument from Evidence Construct an argument with evidence. **(3-LS4-3)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students create clue cards for different organisms, focusing on water-related adaptations. (Wrap-up)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students evaluate each other's predictions and provide suggestions for improvement (Extension)* **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and other reliable media to explain phenomena. **(3-ESS2-2)** • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse*	**ESS2.D: Weather and Climate** Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. **(3-ESS2-2)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.* **LS3.A: Inheritance of Traits** Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. **(3-LS3-2)** • *Students develop a list and/or describe features may need or have to live in each observed ecosystem.* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students predict the fate of an organism and*	**Patterns** Patterns of change can be used to make predictions. **(3-ESS2-2)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.* **Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. **(3-LS3-2),(3-LS4-3)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students develop a list and/or describe features may need or have to live in each observed ecosystem.* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in*

environments. (Wrap-up) • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.* **Constructing Explanations and Designing Solutions** Use evidence (e.g., observations, patterns) to support an explanation. **(3-LS3-2)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students develop a list and/or describe features may need or have to live in each observed ecosystem.* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students evaluate each other's predictions and provide suggestions for improvement (Extension)*	*its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* **LS3.B: Variation of Traits** The environment also affects the traits that an organism develops. **(3-LS3-2)** • *Students develop a list and/or describe features may need or have to live in each observed ecosystem.* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.* **LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. **(3-LS4-3)** • *Students illustrate their understanding of an 'adaptation.'* • *Students develop a list and/or describe features may need or have to live in each observed ecosystem.* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students create clue cards for different organisms, focusing on water-related adaptations. (Wrap-up)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students engage in a citizen science program*	*diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.*

	to help track changes in organisms and the environment through time.	

NGSS Common Core Connections:
ELA/Literacy –

RI.3.1.a–d	Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-ESS2-2),(3-LS3-2),(3-LS4-3)
RI.3.2.a–d	Determine the main idea of a text; recount the key details and explain how they support the main idea. (3-LS3-2),(3-LS4-3)
RI.3.3	Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-2),(3-LS4-3)
RI.3.9	Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2)
W.3.1	Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS4-3)
W.3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (3-LS3-2),(3-LS4-3)
W.3.8	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-ESS2-2)
SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. **a.** Plan and deliver an informative/explanatory presentation on a topic that: organizes ideas around major points of information, follows a logical sequence, includes supporting details, uses clear and specific vocabulary, and provides a strong conclusion. (3-LS3-2),(3-LS4-3)

Additional SEP Connections: Grades 3-5

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions about what would happen if a variable is changed. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.

Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.
Systems and System Models	Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.
Structure and Function	Students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions
Stability and Change	Students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.

Correlation Comments	Correlator Initials: DBB

Water Address correlates well to the 3rd grade NGSS Performance Expectation 3-LS4-3 *as written,* but *does not* correlate well to the CCSS tied to this PE. However, re-aligning the activity to integrate a number of the existing extensions, enhancing and/or highlighting additional student actions already in the activity will help correlate the activity to the CCSS, including the modifications in gray that have students analyzing the connections between climate and adaptations, will correlate the activity to PEs 3-ESS2-2 and 3-LS3-2 and all connecting Language Arts CCSS.

The activity does not include Math – and I didn't see any easy way to include…

Warm-up: Ecosystem & Organism Features

- *Students compare water availability in in different ecosystems based on evidence observed in pictures.*
- *Students develop a list and/or describe features may need or have to live in each observed ecosystem.*
- *Students illustrate their understanding of an 'adaptation.'*

Part I: Connecting Adaptations & the Environment

- *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).*
- *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)*

Part ll: Understanding Ecosystem Relationships

- *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)*
- *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)*
- *Students develop a food/energy web for an organism based on evidence from their research.*

- *Students create clue cards for an organism, focusing on water-related adaptations. (Wrap-up)*

Part III: Engaging in Argument From Evidence

- *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.*
- *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.*
- *Students evaluate each other's predictions and provide suggestions for improvement (Extension)*

Part IV: ActionEducation

- *Students engage in a citizen science program to help track changes in organisms and the environment through time.*

Resources:

California Water Address cards: http://www.watereducation.org/general-information/water-address
- Cards extended to 6 clues; All organisms featured are part of on-going Phenology/climate change studies.

National Phenology Network:
https://www.usanpn.org

Journey North: http://www.learner.org/jnorth/

Project Budburst: http://budburst.org

Project WET: Water Address

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	Ecosystems: Interactions, Energy, and Dynamics	Project WET Guide, Page #: Guide 1.0, Portal

Brief Lesson Description: Students identify plants and animals and their habitats by analyzing clues that describe water-related adaptations of aquatic and terrestrial organisms.

Performance Expectation: MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Performance Expectation: MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. **(MS-LS2-1)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students create clue cards for an organism, focusing on water-related adaptations. (Wrap-up)* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.* **Engaging in Argument from Evidence** Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-LS2-4)** • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on*	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. **(MS-LS2-1)** ***Supplemental DCI PS1.B*** In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. **(MS-LS2-1)** Growth of organisms and population increases are limited by access to resources. **(MS-LS2-1)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students develop a list and/or describe features an organism may need or have to live in each observed ecosystem.* • *Students illustrate their understanding of an 'adaptation.'* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)*	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **(MS-LS2-1)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students develop a list and/or describe features an organism may need or have to live in each observed ecosystem.* • *Students illustrate their understanding of an 'adaptation.'* • *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students develop a food/energy web for an organism based on evidence from their research.* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* **Stability and Change** Small changes in one part of a system might cause large changes in another part. **(MS-LS2-4)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the*

evidence. • *Students evaluate each other's predictions and provide suggestions for improvement (Extension)* .... ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** Science disciplines share common rules of obtaining and evaluating empirical evidence. **(MS-LS2-4)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students illustrate their understanding of an 'adaptation.'* • *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).* • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students develop a food/energy web for an organism based on evidence from their research.* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students evaluate each other's predictions and provide suggestions for improvement (Extension)* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.*	• *Students develop a food/energy web for an organism based on evidence from their research.* • *Students create clue cards for an organism, focusing on water-related adaptations. (Wrap-up)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.* **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. **(MS-LS2-4)** • *Students compare water availability in in different ecosystems based on evidence observed in pictures.* • *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)* • *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)* • *Students develop a food/energy web for an organism based on evidence from their research.* • *Students create clue cards for an organism, focusing on water-related adaptations. (Wrap-up)* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students evaluate each other's predictions and provide suggestions for improvement (Extension)* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.*	*environment. (Extension)* • *Students develop a food/energy web for an organism based on evidence from their research.* • *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.* • *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.* • *Students engage in a citizen science program to help track changes in organisms and the environment through time.*

NGSS Common Core Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-4)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)
RI.8.8	Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4)
WHST.6-8.1	Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)
WHST.6-8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-4)

Additional SEP Connections: Grades 6-8	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to identify and/or clarify evidence and/or the premise(s) of an argument.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that require sufficient and appropriate empirical evidence to answer.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Scale, Proportion, and Quantity	Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Energy and Matter	Students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.
Structure and Function	Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Stability and Change	Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** DBB

The content of Water Address correlates well to the MS grades NGSS Performance Expectations MS-LS2-1 and MS-LS2-4*,* but the activity itself *does not* correlate well to the PE dimensions or the CCSS tied to each PE *as written*. However, re-aligning the activity to integrate a number of the existing extensions, enhancing and/or highlighting additional student actions already in the activity will help correlate the activity to the CCSS – including the modifications in gray that have students analyzing the connections between climate and adaptations.

The content level and amount of information of the cards also needs to be increased to be grade-appropriate for MS (which is another reason for the gray PEs) and suggest using the California version of the cards as an example – Cards for each grade level of NGSS correlations can be developed and made available through the Portal, as could readings to provide more detail for each organism for schools that may not have good access to research resources.

Warm-up: Ecosystem & Organism Features

- *Students compare water availability in in different ecosystems based on evidence observed in pictures.*
- *Students develop a list and/or describe features may need or have to live in each observed ecosystem.*
- *Students illustrate their understanding of an 'adaptation.'*

Part I: Connecting Adaptations & the Environment

- *Students identify an organism and its environment based on a set of clues describing adaptations to water (steps 4 and 5).*
- *Students create a chart of adaptations identified in the activity to compare how they enable plants and animals to live in diverse environments. (Wrap-up)*

Part II: Understanding Ecosystem Relationships

- *Students write a detailed description or draw a picture of an organism's habitat, including the annual climate and weather found in the environment. (Extension)*
- *Students write a detailed description or draw a picture of how an organism obtains and uses water to survive in its natural environment based on research (Extension)*
- *Students develop a food/energy web for an organism based on evidence from their research.*
- *Students create clue cards for an organism, focusing on water-related adaptations. (Wrap-up)*

Part III: Engaging in Argument From Evidence

- *Students predict the fate of an organism and its ecosystem in a warmer or cooler climate.*
- *Students predict potential changes in adaptations that may help an organism survive in a changing climate based on evidence.*
- *Students evaluate each other's predictions and provide suggestions for improvement (Extension)*

Part IV: ActionEducation

- *Students engage in a citizen science program to help track changes in organisms and the environment through time.*

Resources:

California Water Address cards: http://www.watereducation.org/general-information/water-address
- Cards extended to 6 clues; All organisms featured are part of on-going Phenology/climate change studies.

National Phenology Network:
https://www.usanpn.org

Journey North: http://www.learner.org/jnorth/

Project Budburst: http://budburst.org

Project WET: Water Audit

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: K-2	**Topic:** Earth Systems	**Project WET Guide, Page #:** Guide 2.0, p. 469
Brief Lesson Description: Students discuss water sources and water conservation concepts, conduct a home and school water audit, and compare and contrast results with and without the implementation of water conservation practices. Based on water and monetary savings, they then make recommendations for personal conservation strategies at home. (Pre K through 2 Activity)		
Performance Expectation: K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air and/or other living things in the local environment.		
Performance Expectation: 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Obtaining, Evaluating, and Communicating Information Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. **(K-ESS3-3)** • *Students make a list or take pictures of water and its use. (Step 2)* • *Students draw a map of all of the places where they found water around school. (Step 3)* **Developing and Using Models** Develop a model to represent patterns in the natural world. **(2-ESS2-2)** • *Students draw a map of all of the places where they found water around school. (Step 3)*	**ESS3.C: Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. **(K-ESS3-3)** • *Students tell how they use water at home and school. (Warm Up)* • *Students answer what can they do to save water? (Wrap Up)* **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. ***(secondary to K-ESS3-3)*** • *Students draw a map of all of the places where they found water around school. (Step 3)* **ESS2.B Plate Tectonics and Large-Scale System Interaction** Maps show where things are located. One can map the shapes and kinds of land and water in any area. **(2-ESS2-2)** • *Students walk around school and look for water. (Step 1)* • *Students make a list or take pictures of water and its use. (Step 2)* • *Students draw a map of all of the places where they found water around school. (Step 3)*	**Cause and Effect** Events have causes that generate observable patterns. **(K-ESS3-3)** • *Students tell how they use water at home and school. (Warm Up)* • *Students answer what can they do to save water? (Wrap Up)* **Patterns** Patterns in the natural world can be observed. **(2-ESS2-2)** • *Students tell how they use water at home and school. (Warm Up)* • *Students answer what can they do to save water? (Wrap Up)*
NGSS Common Core Connections: **ELA/Literacy –** **W.K.2** Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS3-3)		

SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-ESS2-2)
Mathematics –
MP.2 Reason abstractly and quantitatively. (2-ESS2-2)
MP.4 Model with mathematics. (2-ESS2-2)
2.NBT.A.3 Read and write numbers to 1000 using base-ten numerals, number names and expanded form. (2-ESS2-2)

Connections for Water Audit to other Common Core Standards at this Grade Level:
RI.K.9, SL.K-2.1, W.K-2.6, W.K-2.8, K.MD.3, K.MD.2

Additional SEP Connections: Grades K-2	
Developing and using models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation in collaboration with peers (for K). • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.
Analyzing and interpreting data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Additional Crosscutting Concepts by Grade Level K-2	
	No additional CCC for K-2

Correlation Comments	Correlator Initials: ELC

For grades K-2, there was much debate about which PEs fit with this activity. In the end, the correlator did add in K-ESS3-3, but K-ESS2-2 was also suggested. It looked like the ESS3.C Human Impacts on Earth's Systems information for these two PEs was exactly the same and as the correlator felt that K-ESS3-3 was a better match, went with that one. It was assumed that the ESS3.C piece was the part that seemed to fit. One reviewer did not think that 2-ESS2-2 fit, but the activity directions of drawing a map to indicate the presence of water in an area (and land would be part of the drawing), is in fact, a model., so the correlator went with this one as well.

Project WET: Water Audit

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** Blue text represents the Extension section of the activity.*

Grade: 5	Topic: Earth and Human Activity	Project WET Guide, Page #: Guide 2.0, p. 469
Brief Lesson Description: Students discuss water sources and water conservation concepts, conduct a home and school water audit, and compare and contrast results with and without the implementation of water conservation practices. Based on water and monetary savings, they then make recommendations for personal conservation strategies at home.		
Performance Expectation: 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating and communicating information in 3-5 builds on K-2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. • *Students research cost of technological changes (retrofitting home fixtures) and determine how long it takes to pay for the retrofit. (Part II, Step 4)* • *Students work in teams to look at all facets of school water use, patterns of use and interview those who use water at school. (Part III, Step 2, ActionEducation)* • *Students analyze and summarize data, identify areas of concern and list conclusion. (Part III, Step 5, ActionEducation)* • *Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, ActionEducation)* • *Students write down 3-5 short-term and long-term goals or recommendations for decreasing water consumption. (Wrap Up)*	**ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But, individuals and communities are doing things to help protect Earth's resources and environments. **(5-ESS3-1)** • *Students set goals and identify strategies to decrease water use. (Part II, Step 3)* • *Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, ActionEducation)* • *Students write down 3-5 short-term and long-term goals or recommendations for decreasing water consumption. (Wrap Up)*	**Systems and System Models** A system can be described in terms of its components and their interactions. **(5-ESS3-1)** • *Students work in teams to look at all facets of school water use, patterns of use and interview those who use water at school. (Part III, Step 2)* ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** Science findings are limited to questions that can be answered with empirical evidence. **(5-ESS3-1)** • *Students work in teams to look at all facets of school water use, patterns of use and interview those who use water at school. (Part III, Step 2, ActionEducation)* • *Students analyze and summarize data, identify areas of concern and list conclusion. (Part III, Step 5, ActionEducation)* • *Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, ActionEducation)*
NGSS Common Core Connections: **ELA/Literacy –** **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS3-1) (Part II) **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital resources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1) (Part II) **W.5.9** Draw evidence from literary or informational texts to support analysis, reflections, and research. *(5-ESS3-1)* (Part II)		

Mathematics –
MP.2 Reason abstractly and quantitatively. *(5-ESS3-1)*
MP.4 Model with mathematics. *(5-ESS3-1)*

Connections for Water Audit to other Common Core Standards at this Grade Level:
W.5.7
SL.5.4
SL.5.1d and SL.5.2

Additional SEP Connections: Grades 3-5	
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions. (Part III, Step 2, ActionEducation)

Correlation Comments	Correlator Initials: ELC
No additional comments.	

Project WET: Water Audit

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	**Topic:** Earth and Human Activity	**Project WET Guide, Page #:** Guide 2.0, p. 469
Brief Lesson Description: Students discuss water sources and water conservation concepts, conduct a home and school water audit, and compare and contrast results with and without the implementation of water conservation practices. Based on water and monetary savings, they then make recommendations for personal conservation strategies at home.		
Performance Expectation: MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles and theories. Apply scientific principles to design and object, tool, process or system **(MS-ESS3-3)**. Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. • *Students work in teams to look at all facets of school water use, patterns of use and interview those who use water at school. (Part III, Step 2, Action Education)* • *Students analyze and summarize data, identify areas of concern and list conclusions. (Part III, Step 5, Action Education)* • *Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, Action Education)* • *Students write down 3-5 short-term and long-term goals or recommendations for decreasing water consumption. (Wrap Up)*	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **(MS-ESS3-3)** • *Students set goals and identify strategies to decrease water use. (Part II, Step 3)* • *Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, Action Education)* • *Students write down 3-5 short-term and long-term goals or recommendations for decreasing water consumption. (Wrap Up)*	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **(MS-ESS3-3)** • *Students compare perceived water use versus actual water use at home or at school. (Part I)* ***Connections to Engineering, Technology, And Applications of Science*** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **(MS-ESS3-3)** • *Students consider benefits to retrofitting existing fixtures to conserve water. (Part II, Step 4))* • *Students analyze and summarize data, identify areas of concern and list conclusions. (Part III, Step 5, Action Education)* • *Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, Action Education)*
NGSS Common Core Connections: **ELA/Literacy –** **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3) (Part II and Part III) **WHST.6-8.8** Gather relevant information from multiple print and digital sources, assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic (MS-ESS3-3) (Part II) **Mathematics –** **6.RP.A.1** Understand the concept of a ratio and use ratio to describe a ratio relationship between two quantities. (MS-ESS3-3) **7.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-ESS3-3) **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-3)		

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-3)

Connections to other Common Core Standards at this Grade Level:
ELA: W.6-8.7, W.6-8.8, W.6-8.9, RST.6-8.3, RH.6-8.8, SL.6-8.4, SL.6-8.1d, SL.6-8.2
Math: 6.NS.3

Additional SEP Connections: Grades 6-8	
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Correlation Comments	**Correlator Initials:** ELC
This activity could also lead to MS-LS2-1.	

Project WET: Water Audit

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: **HS**	**Topic:** Earth and Human Activity	**Project WET Guide, Page #:** Guide 2.0, p. 469

Brief Lesson Description: Students discuss water sources and water conservation concepts, conduct a home and school water audit, and compare and contrast results with and without the implementation of water conservation practices. Based on water and monetary savings, they then make recommendations for personal conservation strategies at home.

Performance Expectation: : Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

<table>
<tr><th>Science & Engineering Practice(s)</th><th>Disciplinary Core Idea(s)</th><th>Crosscutting Concept(s)</th></tr>
<tr>
<td>Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Create a computational model or simulation of a phenomenon, designed device, process, or system.
(HS-ESS3-3)
• Students analyze and summarize data, identify
• Students analyze and summarize data, identify areas of concern and list conclusions. (Part III, Step 5, Action Education)
• Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, Action Education)</td>
<td>ESS3.C: Human Impacts on Earth Systems
The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
• Students consider benefits to retrofitting existing fixtures to conserve water. (Part II, Step 4))
• Students work in teams to look at all facets of school water use, patterns
• Students work in teams to look at all facets of school water use, patterns of use and interview those who use water at school. (Part III, Step 2, Action Education)
• Students analyze and summarize data, identify areas of concern and list conclusions. (Part III, Step 5, Action Education)
• Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, Action Education)
• Students write down 3-5 short-term and long-term goals or recommendations for decreasing water consumption. (Wrap Up)</td>
<td>Stability and Change
Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3)
• Students analyze and summarize data, identify areas of concern and list conclusions. (Part III, Step 5, Action Education)
• Student teams develop a school-wise water conservation plan and prepare a presentation with their ideas. (Part III, Steps 7-12, Action Education)
• Students write down 3-5 short-term and long-term goals or recommendations for decreasing water consumption. (Wrap Up

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World
Modern civilization depends on major technological systems. (HS-ESS3-3)
New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3)
• Students consider benefits to retrofitting existing fixtures to conserve water. (Part II, Step 4))

Connections to Nature of Science

Science is a Human Endeavor
Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3)</td>
</tr>
</table>

NGSS Common Core Connections:
ELA/Literacy –

Mathematics-
MP.4 Model with mathematics. (HS-ESS3-3)

Connections to other Common Core Standards at this Grade Level: W.9-12.7, W.9-12.8, W.9-12.9, RST.9-12.3, SL.9-12.4, SL.9-12.1d , SL.9-12.2

Additional SEP Connections: Grades 9-12	
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. Select appropriate tools to collect, record, analyze, and evaluate data.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Scale, Proportion, and Quantity	Students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.
Stability and Change	Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments	**Correlator Initials:** ELC
This activity could also lead to HS-LS2-2, HS-LS2-7 and HS-ETS1-2 and HS-ETS1-3. Another reviewer also suggested an easy connection to HS-ESS3-4, with some additional links to water use in other technologies.. The Engineering and Design standards are particularly strong, but the other life science/biology connections could also be made with intentional small additions by teachers. In addition, we could easily add into the instructions specifics about recording data and putting it into a spreadsheet that would serve as a computational simulation. Students are already asked to make recommendations or provide solutions to their findings in their water audits, so putting the data into other formats is a logical next step.	

Project WET: Water Crossings

* Activities are correlated as written. However, by using the extensions or adapting the activity using the grey-shaded text, additional correlations or parts of correlations are met.

** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 3-5	Engineering Design	Project WET Guide, Page #: Guide 2.0, p. 487
Brief Lesson Description: Students participate in a water crossing contest in which they must move their possessions (a hard-boiled egg) across a span of water (a cake pan).		
Performance Expectation: 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.		
Performance Expectation: 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		

Science & Engineering Practice(s)	Disciplinary Core Idea(s)	Crosscutting Concept(s)
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. **(3-5-ETS1-1)** • *Tell students they are about to gain insight into some of the challenges pioneers faced when they arrived at a river; they are going to participate in a water-crossing contest! The goal of the contest is for small groups of students to plan, design and construct a means of carrying a load across a body of water. (Activity, Part II, Step 1)* • *Divide the class into small groups. Each team will build a water crossing conveyance from natural materials collected from front yards, city parks and school grounds. (Activity, Part II, Step 2)* • *Inform students that the load to be transported is a hard-boiled egg (or rock or tennis ball). Once each team has built its conveyance, an egg is placed in the center and the whole thing is floated in a bucket or dishpan. The conveyance must support the load for two minutes while not touching the sides or the bottom of the bucket or dishpan. If the structure does not crack, capsize or fall apart within two minutes, the team has succeeded in crossing the barrier. (Activity, Part II, Step 3)* • *Conduct a bridge-building contest. (Extension)* **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems	**ETS1.A: Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **(3-5-ETS1-1)** • *Divide the class into small groups. Each team will build a water crossing conveyance from natural materials collected from front yards, city parks and school grounds. Since each team gets only one chance to succeed, encourage groups to discuss their options (e.g., a ferry, raft, wherry [a light, swift boat built for one person], etc.) before beginning construction. (Activity, Part II, Step 2)* • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4)* • *Allow students to test their water-crossing conveyance designs and then improve upon them before the final contest for a variation on the activity. Have students analyze how the process was different and what the results were for each. (Extension)* • *Conduct a bridge-building contest. (Extension)* **ETS1.B: Developing Possible Solutions** Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **(3-5-ETS1-3)** • *Inform students that the load to be transported is a hard-boiled egg (or rock or*	**Influence of Science, Engineering, and Technology on Society and the Natural World** People's needs and wants change over time, as do their demands for new and improved technologies. **(3-5-ETS1-1)** • *Allow students to test their water-crossing conveyance designs and then improve upon them before the final contest for a variation on the activity. Have students analyze how the process was different and what the results were for each. (Extension)*

in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. **(3-5-ETS1-3)** • *Inform students that the load to be transported is a hard-boiled egg (or rock or tennis ball). Once each team has built its conveyance, an egg is placed in the center and the whole thing is floated in a bucket or dishpan. The conveyance must support the load for two minutes while not touching the sides or the bottom of the bucket or dishpan. If the structure does not crack, capsize or fall apart within two minutes, the team has succeeded in crossing the barrier. (Activity, Part II, Step 3)* • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4)* • *Allow students to test their water-crossing conveyance designs and then improve upon them before the final contest for a variation on the activity. Have students analyze how the process was different and what the results were for each. (Extension)* • *Conduct a bridge-building contest. (Extension)*	*tennis ball). Once each team has built its conveyance, an egg is placed in the center and the whole thing is floated in a bucket or dishpan. The conveyance must support the load for two minutes while not touching the sides or the bottom of the bucket or dishpan. If the structure does not crack, capsize or fall apart within two minutes, the team has succeeded in crossing the barrier. (Activity, Part II, Step 3)* • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4)* • *Allow students to test their water-crossing conveyance designs and then improve upon them before the final contest for a variation on the activity. Have students analyze how the process was different and what the results were for each. (Extension)* • *Conduct a bridge-building contest. (Extension)* **ETS1.C: Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. **(3-5-ETS1-3)** • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4)* • *Allow students to test their water-crossing conveyance designs and then improve upon them before the final contest for a variation on the activity. Have students analyze how the process was different and what the results were for each. (Extension)* • *Conduct a bridge-building contest. (Extension)*	
NGSS Common Core Connections: ***ELA/Literacy -*** **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-1),(3-5-ETS1-3) **Connections to other Common Core Standards at this Grade Level:** RH.6-8.7; RL.3-12.4; W.3-12.3		

Additional SEP Connections:	
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success

Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
Engaging in argument from evidence	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Correlation Comments	**Correlator Initials:** MJW
*K-2-ETS1-3** *3-5-ETS1-1** *3-5-ETS1-3** *MS-ETS1-2** *MS-ETS1-3** *HS-ESS3-1—the concepts discussed in the wrap up and around this activity fit well with the DCI ESS3.B: Natural Hazards—however, since the method is focused on engineering a vessel to cross a river and less about the geography of natural hazards it is a better fit for the ETS1 PEs* *HS-ETS1—Although this activity meets PEs in Engineering Design at lower levels, the problems addressed by the PEs at the high school level are labeled as "major global challenges" and "complex real world problems" and therefore, although this activity could be used at the HS level, it is probably a better fit for lower levels.*	

Project WET: Water Crossings

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*
** Blue text represents the Extension section of the activity.*

Grade: MS	**Engineering Design**	**Project WET Guide, Page #:** Guide 2.0, p. 487
Brief Lesson Description: Students participate in a water crossing contest in which they must move their possessions (a hard-boiled egg) across a span of water (a cake pan).		
Performance Expectation: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Performance Expectation: MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. **(MS-ETS1-3)** • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4)* **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. • *Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **(MS-ETS1-2)*** • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4)*	**ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. **(MS-ETS1-2), (MS-ETS1-3)** • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4)* • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. **(MS-ETS1-3)** • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4) Suggest that students can combine parts of different solutions during their brainstorming.* **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. **(MS-ETS1-3)** • *Have students vote on the most successful strategy and brainstorm improvements in raft designs for another contest. (Activity, Part II, Step 4) Suggest that students can combine parts of different solutions during their brainstorming.*	**No CCCs listed for these PEs**
NGSS Common Core Connections: **Connections to other Common Core Standards at this Grade Level:** RH.6-8.7; RL.3-12.4; W.3-12.3		

Additional SEP Connections:	
Asking questions (for science) and defining problems (for engineering	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. • Collect data about the performance of a proposed object, tool, process or system under a range of conditions.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. • Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Additional Crosscutting Concepts by Grade Level	
Structure and Function	Students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Correlation Comments	**Correlator Initials:** MJW

*K-2-ETS1-3**
*3-5-ETS1-1**
*3-5-ETS1-3**
*MS-ETS1-2**
*MS-ETS1-3**

HS-ESS3-1—the concepts discussed in the wrap up and around this activity fit well with the DCI ESS3.B: Natural Hazards—however, since the method is focused on engineering a vessel to cross a river and less about the geography of natural hazards it is a better fit for the ETS1 PEs

HS-ETS1—Although this activity meets PEs in Engineering Design at lower levels, the problems addressed by the PEs at the high school level are labeled as "major global challenges" and "complex real world problems" and therefore, although this activity could be used at the HS level, it is probably a better fit for lower levels.

Project WET: What's the Solution?

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: 5	**Topic: Matter and Its Interactions**	**Project WET Guide, Page #:** Guide 2.0, p. 37
Brief Lesson Description: While investigating the dissolving power of water, students solve a crime by differentiating between solutions and other mixtures, and demonstrating water's ability to dissolve solids, liquids and gasses.		
Performance Expectation: 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. **(5-PS1-1)** • *Students work in small groups to conduct experiments with solids, liquids and gases in water. (Activity, p. 41)*	**PS1.A: Structure and Properties of Matter** Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. • *Students work in small groups to conduct experiments with solids, liquids and gases in water. (Activity, p. 41)* A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. **(5-PS1-1)** • *Students work in small groups to conduct experiments with solids, liquids and gases in water. (Activity, p. 41)*	**Scale, Proportion, and Quantity** Natural objects exist from the very small to the immensely large. **(5-PS1-1)**

NGSS Common Core Connections:

ELA/Literacy –

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-PS1-1)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(5-PS1-1),(5-PS1-2)*,(5-PS1-3)

MP.4 Model with mathematics. *(5-PS1-1),*(5-PS1-2),(5-PS1-3)

5.NBT.A.1 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (5-PS1-1)

5.NF.B.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1)

5.MD.C.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1)

5.MD.C.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. (5-PS1-1)

Connections to other Common Core Standards at this Grade Level: None

Additional SEP Connections: Grades 3-5	
Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Developing and using models	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena.
Planning and carrying out investigations	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Analyzing and interpreting data	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Additional Crosscutting Concepts by Grade Level 3-5	
Patterns	Patterns: Students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.
Cause and Effect	Cause and Effect: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Correlation Comments	Correlator Initials: ELC

This activity does not completely address this PE, due to the activity outlining the procedure, but still is close to the idea of "develop"ing a model. The teacher and activity dictate the model, rather than including some student development…

Activity Note: On Page 41, for the Dissolving Solids in Water experiment, I recommend to *not* be so specific for the MS and HS level, and probably not for 5th grade either. Don't tell that A is a solution and B is a suspension. We can mention those words, but see if they can figure out which one is which. It would perhaps require another question on the right to see if they know which one is the solution. It is a 50/50 guess anyway, but they should be familiar with sugar and water and thus, can probably figure out which one is the solution. It always goes back to inquiry teaching for me and what can we let students discover on their own.
Again, on Dissolving Liquids in Water, the same could be said. You can give them the hint to look closely, but then we go ahead and tell them what they should see…*not* good inquiry teaching. Teachers will need to know these hints/answers, but they shouldn't be on student pages.

Project WET: Water Quality? Ask the Bugs!

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: MS	**Ecosystems: Interactions, Energy and Dynamics**	**Project WET Guide, Page #:** Guide 2.0, p.421

Brief Lesson Description: Students conduct a simulated bioassessment of a stream by sampling aquatic macroinvertebrates (represented by ordinary materials). By learning the process by which macroinvertebrates are assessed, results are recorded and Pollution Tolerance Indexes are determined. Students are given opportunities to learn monitoring techniques in a classroom setting before doing field monitoring.

Performance Expectation: MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Science & Engineering Practice(s)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. **(MS-LS2-4)**

- *Have students write a paragraph that describes their stream based on the macroinvertebrate sample they collected. If they sampled an impaired stream, they should describe the habitat, address possible pollution sources and give other pertinent details. Allow them to be creative. (Wrap Up)*

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science disciplines share common rules of obtaining and evaluating empirical evidence. **(MS-LS2-4)**
- *Instruct students to simulate a rapid bioassessment at their stream sampling site as follows: (Activity, Step 6)*
- *Have students compare their results with the other groups. What were the similarities and differences between the three sites? Which stream had the highest level of water quality? The lowest? (Activity, Step 7)*
-

Disciplinary Core Idea(s)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. **(MS-LS2-4)**

- *Divide students into 11 groups and distribute copies of the Macroinvertebrate Identification Chart to each group. Through assignment, have each group adopt one macroinvertebrate group. Have each group research their macroinvertebrate…Tolerant or intolerant to pollution (Warm Up)*
- *Briefly explain to students that aquatic macroinvertebrates are used as indicators of the relative health of a stream and that the common form of sampling them is called a bioassessment, which they will conduct in this activity. (Warm Up)*
- *Instruct students to simulate a rapid bioassessment at their stream sampling site as follows: (Activity, Step 6)*
- *Have students compare their results with the other groups. What were the similarities and differences between the three sites? Which stream had the highest level of water quality? The lowest? (Activity, Step 7)*
- *Have students locate specific aquatic macroinvertebrate identification keys for their watershed, state or region. Research the pollution tolerance, habitat, and regional distribution of the individual species. (Extension)*

Crosscutting Concept(s)

Stability and Change
Small changes in one part of a system might cause large changes in another part. **(MS-LS2-4), (MS-LS2-5)**

- *Briefly explain to students that aquatic macroinvertebrates are used as indicators of the relative health of a stream and that the common form of sampling them is called a bioassessment, which they will conduct in this activity. (Warm Up)*
- *Have students write a paragraph that describes their stream based on the macroinvertebrate sample they collected. If they sampled an impaired stream, they should describe the habitat, address possible pollution sources and give other pertinent details. Allow them to be creative. (Wrap Up)*

NGSS Common Core Connections:
ELA/Literacy -

WHST.6-8.1	Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2)

Mathematics - 6.SP.B.5 Summarize numerical data sets in relation to their context. *(MS-LS2-2)* **Connections to other Common Core Standards at this Grade Level:** ***ELA***: RST.6-12.4; SL.6-12.4; WHST.6-12.10 ***Math***: 5.OA.5; 6.RP.3c; 6.SP.5; 7.SP.1; 7.SP.2; S-IC.1

Additional SEP Connections:	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
	• Ask questions
	  • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
	  • to determine relationships between independent and dependent variables and relationships in models.
	  • to clarify and/or refine a model, an explanation, or an engineering problem.
	  • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
	  • that challenge the premise(s) of an argument or the interpretation of a data set.
	  • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (Action Education)

Developing and using models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of a model for a proposed object or tool. • Develop and/or use a model to predict and/or describe phenomena. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (Action Education) • Evaluate the accuracy of various methods for collecting data. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Analyze and interpret data to provide evidence for phenomena. • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). • Analyze and interpret data to determine similarities and differences in findings. Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Using mathematics and computational	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • Construct an explanation using models or representations. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real world phenomena, examples, or events. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
Engaging in argument from evidence	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.
Obtaining, evaluating, and communicating information	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods. Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Additional Crosscutting Concepts by Grade Level	
Patterns	Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Systems and System Models	Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.

Correlation Comments	**Correlator Initials:** MJW

Project WET: Water Quality? Ask the Bugs!

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** Gray shaded areas demonstrate additional connections that can be made/strengthened with a few minor additions and/or restructuring of activity.*

** Blue text represents the Extension section of the activity.*

Grade: HS	Life Sciences: Ecosystems: Interactions, Energy and Dynamics	**Project WET Guide, Page #:** Guide 2.0, p. 421
Brief Lesson Description: Students conduct a simulated bioassessment of a stream by sampling aquatic macroinvertebrates (represented by ordinary materials). By learning the process by which macroinvertebrates are assessed, results are recorded and Pollution Tolerance Indexes are determined. Students are given opportunities to learn monitoring techniques in a classroom setting before doing field monitoring.		
Performance Expectation: HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. **(HS-LS2-6)** • *Ask students what they think of this type of scientific sampling process. Do students feel that they could use this same process to perform a bioassessment in an actual stream? Did their samples accurately reflect the population of invertebrates in their stream? How do they know? Ask students to brainstorm how the process could be modified to increase its accuracy (e.g., conduct the sampling three times for each stream and compare or average the results). (Wrap Up)* • *Have them identify positive and negative aspects of this type of sampling. For example, do they believe that they netted larger insects more easily than smaller insects? Can such biased sampling occur in an actual rapid bioassessment of invertebrates? (Wrap Up)* • *Discuss the idea of the Pollution Tolerance Index—how it is created, what it means. Do students think this is a useful tool? Does it work?*	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. **(HS-LS2-2), (HS-LS2-6)** • *Briefly explain to students that aquatic macroinvertebrates are used as indicators of the relative health of a stream and that the common form of sampling them is called a bioassessment, which they will conduct in this activity. (Warm Up)* • *Instruct students to simulate a rapid bioassessment at their stream sampling site as follows…Students using the Macroinvertebrate Data Sheet I tabulate the sorting results onto the data sheet and calculate the percent composition of each macroinvertebrate in the stream site. Students with Macroinvertebrate Data Sheet II use the data from Data Sheet I to complete the Pollution Tolerance Index to determine the Water Quality Assessment score for their stream sample. (Activity, Step 6)* • *Have students compare their results with the other groups. What were the similarities and differences between the three sites? Which stream had the highest level of water quality? The lowest? (Activity, Step 7)* • *Have students write a paragraph that describes their stream based on the*	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. **(HS-LS2-6), (HS-LS2-7)** • *Ask students why it's important to conduct a bioassessment of a stream. (The presence or absence of different organisms can be a determining factor in the use of the water or the required treatment for use. For example, a polluted stream will require more treatment than a stream with high quality water. Testing and measuring water quality are required to determine whether bodies of water meet specified water-quality standards.) (Wrap Up)* • *Discuss the idea of the Pollution Tolerance Index—how it is created, what it means. Do students think this is a useful tool? Does it work?*

	macroinvertebrate sample they collected. If they sampled an impaired stream, they should describe the habitat, address possible pollution sources and give other pertinent details. Allow them to be creative. (Wrap Up)	

NGSS Common Core Connections:

Connections to other Common Core Standards at this Grade Level:
ELA: RST.6-12.4; SL.6-12.4; WHST.6-12.10
Math: 5.OA.5; 6.RP.3c; 6.SP.5; 7.SP.1; 7.SP.2; S-IC.1

Additional SEP Connections:	

Asking questions (for science) and defining problems (for engineering)	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
	• Ask questions
	  • that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
	  • to determine relationships, including quantitative relationships, between independent and dependent variables.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Developing and using models	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.
Constructing explanations (for science) and designing solutions (for engineering)	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Engaging in argument from evidence	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.
Obtaining, evaluating, and communicating	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Additional Crosscutting Concepts by Grade Level	
Patterns	Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Systems and System Models	Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Correlation Comments	**Correlator Initials:** MJW
This is a pretty good fit, but to truly stay in the spirit of the SEP more emphasis needs to be placed on • *How and why the Pollution Tolerance Index numbers came about* • *What they indicate and if that is accurate* • *If evidence collected in real streams supports the Pollution Tolerance Index concept*	

Project WET: Your Hydrologic Bank Account

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** Blue text represents the Extension section of the activity.*

Grade: MS		**Project WET Guide, Page #:** Guide 2.0, p. 223
Brief Lesson Description: Students calculate and analyze simplified hydrologic budgets for a fictional watershed from the western United States.		
Performance Expectation: NA		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy –*** **NA** ***Mathematics –*** **NA** ***Connections to other Common Core Standards at this Grade Level:*** **ELA/Literacy:** SL.6-8.1, SL.6-8.2 **Math:** 6.NS.3, 6.RP.3c, 6.SP.4		

Additional SEP Connections: Grades 6-8	
Planning and carrying out investigations	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
Analyzing and interpreting data	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings. Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.
Using mathematics and computational thinking	Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions.

Additional Crosscutting Concepts by Grade Level 6-8	
Patterns	Patterns: Students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.
Cause and Effect	Cause and Effect: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Systems and System Models	Systems and System Models: Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.
Stability and Change	Stability and Change: Students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.

Correlation Comments	**Correlator Initials:** ELC

Your Hydrologic Bank Account does not directly lead to any MS NGSS, but it could serve as a lead in to 3 NGSS Performance Expectations.

MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Since the emphasis in this activity is on western watersheds, *drought* might be the topic to consider as the “natural hazard”. Then, to extend this activity further, what might be done if there are years of drought? Where will people get their water? These questions to address also then lead into the next NGSS PE…

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems.

Once again, where will people get their water, if water is scarce and more and more people are living in an area and they all need water, along with the other water users too? (*8-4-1, One for All* uses water users as the theme for this activity)

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relative scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

As another Extension for this activity, why not have students come up with solutions to prolonged years of drought and the need for water in their area? This would best be done on the local level.

Another suggestion, related to the activity, as written: It could be stronger in support of the NGSS SEPs if students were asked to *construct an explanation* in some way. They do the math, and graph it, but then aren’t asked to do anything else with the information…at the very least, as a teacher, I would want them to have to explain their findings to the others in a group, or better yet, write it out in some way, in addition to the graph. What if they were asked to determine if their graphs represented flood, drought or adequate water supply and then provide the evidence to support their answer? The first Extension asks them to consider the ten-year data, which could also be important for students to consider.

Project WET: Your Hydrologic Bank Account

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** Blue text represents the Extension section of the activity.*

Grade: HS		**Project WET Guide, Page #:** Guide 2.0, p. 223
Brief Lesson Description: Students calculate and analyze simplified hydrologic budgets for a fictional watershed from the western United States.		
Performance Expectation: NA		
Performance Expectation:		
Science & Engineering Practice(s)	**Disciplinary Core Idea(s)**	**Crosscutting Concept(s)**
NA	**NA**	**NA**
NGSS Common Core Connections: ***ELA/Literacy –*** **NA** ***Mathematics –*** **NA** ***Connections to other Common Core Standards at this Grade Level:* ELA/Literacy** - RST.9-10.7 **Math -** NA		

Additional SEP Connections: Grades 9-12	
Planning and carrying out investigations	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. • Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. Select appropriate tools to collect, record, analyze, and evaluate data.
Analyzing and interpreting data	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

Using mathematics and computational thinking	Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3 , acre-feet, etc.)

Additional Crosscutting Concepts by Grade Level 9-12	
Patterns	Patterns: Students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
Cause and Effect	Cause and Effect: Students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
Systems and System Models	Systems and System Models: Students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.
Stability and Change	Stability and Change: Students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Correlation Comments	**Correlator Initials:** ELC

Your Hydrologic Bank Account does not directly lead to any HS NGSS, but it could serve as a lead in to 2 NGSS Performance Expectations.

HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards and changes in climate have influenced human activity.

Las Vegas comes to mind as a city built in a desert area that has an increasing population, at least in part to tourism. How much water is available to its residents and visitors? Do they have enough for their population to increase? Will changes in climate have any influence on how much water will be available in the future? Do they have a carrying capacity for their population, based on water availability?

HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

What happens over time, if water resources are not managed properly? Where will the extra water needed for an expanding population come from?

In addition, this activity could be expanded to be an Engineering activity and work with both HS-ETS1-1 and HS-ETS1-2.

HS-ETS1-1: Analyze a major global challenge to specify quantitative and qualitative criteria and constraints for solutions that account for societal needs and wants.

Water availability is a global challenge and issue and would be an easy one to use for this particular NGSS PE.

HS-ETS1-2: Design a solution to a complex, real-world problem by breaking it down into smaller more manageable problems that can be solved through engineering.

What suggestions and ideas do students have to help solve the water issues found in our world? What could be done in the Western US? What could be done at their own local level?

Finally, here is the same suggestion that I made for the MS NGSS for this activity:
Another suggestion, related to the activity, as written: It could be stronger in support of the NGSS SEPs if students were asked to *construct an explanation* in some way. They do the math, and graph it, but then aren't asked to do anything else with the information…at the very least, as a teacher, I would want them to have to explain their findings to the others in a group, or better yet, write it out in some way, in addition to the graph. What if they were asked to determine if their graphs represented flood, drought or adequate water supply and then provide the evidence to support their answer? At that point, several SEPs from the Constructing an Explanation and also the Obtaining and Communicating SEP would be addressed. The first Extension asks them to consider the ten-year data, which could also be important for students to consider.

www.projectwet.org
wetusa@projectwet.org.

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