ENGINEERING AND WATER

Engineers analyze problems, design solutions and then provide guidance for planning and management of those solutions. In the case of water resources, these problems and solutions are likely urban infrastructure tasks and flood control. Water-related engineering designs are found everywhere there are people: in dams, retention ponds, water treatment plants, drinking water facilities, water and flood control management systems, landfills, and many other areas. To work on these designs, engineers must be familiar with the qualities and properties of water, as well as, climate and weather, physics, chemistry, geology, and the needs of communities and the environment.

There are many specialties within the engineering field involved with water: *Civil and geotechnical engineers* must have a comprehensive understanding of soil mechanics, groundwater flow and runoff in order to properly design systems to manage stormwater. *Environmental engineers* must understand the movement of water as it percolates through different soil layers to design technologies that address water quality and treatment of stormwater, groundwater and remediation projects. *Environmental and civil engineers* guard the quality of our water resources in many ways. They design water and sewage treatment plants that clean water for human use, and design industrial systems and filters that make sure factory-released water is not polluting our environment. Furthermore, *environmental engineers* help clean up water sources and air that are polluted. They are challenged to clean the groundwater and restore it to a natural or usable state so that it remains free of harmful chemicals that could contaminate the drinking water supply and make people sick.

CONNECTING ENGINEERING ACTIVITIES WITH PROJECT WET

TEACHENGINEERING curriculum for k-12 teachers

The website, **teachengineering.org** provides thousands of free quality engineering activities for k-12 students. The water-related engineering activities or lessons are paired below with Project WET activities and water-related topics.

Water Quantity:

Today's engineers are taking on the responsibility of creating sustainable solutions to the 21st century's big engineering challenges. Water scarcity, contamination, and climate change may necessitate engineering solutions involving water redistribution, desalinization, filtration and retention. Rain gardens, permeable surfaces, reimagined agricultural practices, and dams are just a few engineering feats that keep more of the water in place where it can recharge the groundwater reserves and promote natural stormwater management.

GEORGIA PROJECT WET Water Education for Teachers

A Drop in the Bucket. Try the following engineering projects (from **teachengineering.org)** with this activity:

- Natural and Urban "Stormwater" Water Cycle Models
- Rain Garden Construction
- Infiltration Rates and Storage Capacities of various materials
- Measuring Transpiration Rates
- Making "Magic" Sidewalks of Pervious Pavement
- Ocean Water Desalinization

Water on Earth:

Engineers around the world design the tools and processes to find and extract raw materials from the Earth's crust to create safe roads, vehicles, structures, electronics, chemicals and electricity upon which we depend. Engineers decide placement of the highways, tracks and bridges of our transportation infrastructure, as well as the telephone cables, electricity transmission towers and power generation plants (including wind, water and solar) that enable communication and supply electricity. Some engineers investigate the soil types, erosion forces, and climatic environmental conditions. Other engineers examine landforms as they apply to mining, natural hazards and environmental protection, creating tools such as satellite imagery for mapping. To provide clean water for communities, engineers must understand the water cycle and local resources as they design treatment plants and distribution systems that are continually being challenged with polluted water sources.

Blue Planet. Try the following engineering projects (from **teachengineering.org)** with this activity:

- Can You Catch the Water? (3-dimensional models of water catchment basins)
- One World Ocean (ocean currents and salt and fresh water differences)
- Snow vs. Water (weather and making snow)

Water Chemistry:

Environmental engineers are specialists in a wide variety of topics concerning our natural world, energy and the sustainability of our planet. Understanding the chemistry of water allows engineers to study areas such as global climate change, reducing atmospheric carbon dioxide, alternative fuel sources, and groundwater quality. Because of the importance of worldwide clean drinking water, some engineers have developed remediation technologies for contaminated groundwater. Skills important to engineers include problem solving and design, preparing presentations and lectures, communication and creativity, as well as a good working knowledge of the physical and chemical properties and behavioral characteristics of water and contaminants.

Is there Water on Zork? Try the following engineering projects (from **teachengineering.org)** with this activity:

- Thinking Green! (critically thinking about the products and services in their lives)
- Chromatography Lab
- Red Cabbage Chemistry
- Water Remediation Lab
- Density Column Lab - Part 1, 2

Non-Point Source Pollution:

Green infrastructure and low-impact development are decentralized stormwater management strategies that provide on-site water quantity and water quality treatment. These systems utilize physical, chemical and biological principles to improve the water quality of urban stormwater runoff. Under natural conditions (pre-development), stormwater runoff has unabated access to the soil surface. This stormwater runoff recharges the groundwater supply and provides a certain level of stormwater cleansing, improving the long-term security of drinking water supplies and supporting ecosystem function. Green infrastructure is considered a new technology and significant civil and environmental engineering research is underway. Engineers are taking a look at how nature naturally manages stormwater and nutrients and conducting

research to understand how to best design, install and maintain these systems over their anticipated lifespans.

Sum of the Parts Try the following engineering activities (from **teachengineering.org)** with this activity:

- The Dirty Water Project
- Green Infrastructure
- The Great Pacific Garbage Patch

The Water Cycle:

Engineers must fully understand the hydrologic (water) cycle in order to design water structures and operations for our daily life. A comprehensive understanding of the water cycle is important for civil and environmental engineers who design critical infrastructure systems such as reservoirs, stormwater ponds, control structures, dams, levies, treatment facilities and stream flow and base flow. They must account for stormwater runoff, infiltration rates and treatment processes that may interrupt and compete with the natural cycle of water.

An Incredible Journey. Try the following engineering projects (from **teachengineering.org)** with this activity:

- Where has all the Water Gone?
- Natural and Urban "Stormwater" Water Cycle Models

Properties of Water:

Understanding the properties of water or liquids has implications in a wide variety of engineering fields. For example, an inkjet printer depends on the surface tension of the ink turning a jet of liquid into droplets that can be sprayed into position. Environmental and chemical engineers study the interactions between surface tension and chemicals as they develop technologies to remove pollutants from our water and air resources. The surface tension of paints and other surface coatings is carefully designed to ensure that the coating spreads easily while maintaining a desired film thickness. Integrating the scientific understanding of cohesion and adhesion, chemical engineers have created modern materials and coatings so that clothing and other surfaces repel water and are self-cleaning.

H2Olympics. Try the following engineering projects (from **teachengineering.org)** with this activity:

- Break the Tension
- Surface Tension Lab
- Exploring Capillary Action
- Measuring Surface Tension
- Investigating Contact Angle
- Exploring the Lotus Effect