Student Activity Sheet #1
What is Drought?
Perspective Cards
Copy, Cut, and Distribute to Groups

FARMER

A farmer is a person who grows field crops, has orchards, vineyards, or market gardens, and does so with the prospect of selling the produce as food. Farmers may, however, provide raw materials for industrial purposes, such as cereals for alcoholic beverages, fruit for juices, hides for leather, and wool or flax for yarns and cloth-making. Farmers may also be involved in rearing livestock for meat, milk, or other substances (http://en.wikipedia.org/wiki/Farmer).

To a farmer, a drought is a period of moisture deficiency that affects the crops under cultivation. Even two weeks without rainfall can stress many crops during certain periods of the growing cycle.

METEOROLOGIST

A meteorologist is an individual with specialized education who uses scientific principles to explain, understand, observe or forecast the earth's atmospheric phenomena and/or how the atmosphere affects the earth and life on the planet (http://www.ametsoc.org/policy/whatisam.html).

To a meteorologist, a drought is a prolonged period when precipitation is less than normal.

WATER MANAGER

A water manager is someone who might work in many different kinds of municipal, county, or regional areas of water or wastewater management. Water managers might be in state or local government or in private business and are concerned with the supply of available drinking water and the quality of water necessary to protect the health of citizens in their service area.

To a water manager, a drought is a deficiency in water supply that affects water availability and water quality.

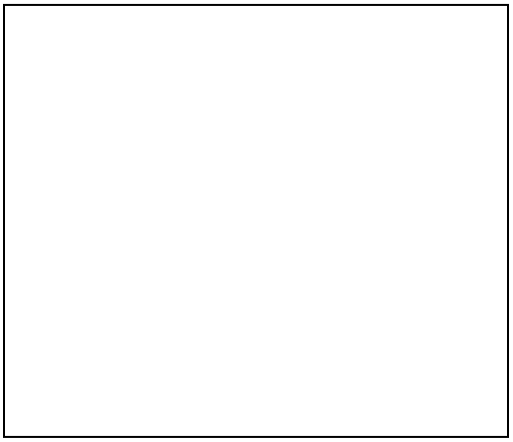
HYDROLOGIST

A hydrologist is a person who applies scientific knowledge and mathematical principles to study water-related problems in society: problems of quantity, quality and availability. Hydrologists may be concerned with finding water supplies for cities or irrigated farms, or controlling river flooding or soil erosion. They may work in environmental protection: preventing or cleaning up pollution or locating sites for safe disposal of hazardous wastes. (http://ga.water.usgs.gov/edu/hydrology.html).

To a hydrologist, a drought is an extended period of decreased precipitation and stream flow.

Student Activity Sheet #2
What is Drought?
In the News!

Write the name of your newspaper and the date on the dark line above the box. In the box below draw a picture or diagram to go along with your drought story. Beside the box, write the title of your news article and your name as the author/reporter. If you need more room, you may use the back of this paper.



Student Activity Sheet #2
What is Drought?
In the News! Rubric

Name: _____

CATEGORY	4	3	2	1
Quality of Information	Information clearly relates to the main topic. It includes several supporting details and/or examples.	Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.	Information clearly relates to the main topic. No details and/or examples are given.	Information has little or nothing to do with the main topic.
Mechanics	No grammatical, spelling or punctuation errors.	Almost no grammatical, spelling or punctuation errors.	A few grammatical, spelling, or punctuation errors.	Many grammatical, spelling, or punctuation errors.
Organization	Information is very organized with well-constructed paragraphs and subheadings.	Information is organized with well-constructed paragraphs.	Information is organized, but paragraphs are not well constructed.	The information appears to be disorganized and leaves the reader unclear about author's point.
Diagrams & Illustrations	Diagrams and illustrations are neat, accurate and add to the reader's understanding of the topic. A caption for the illustration/diagram is provided.	Diagrams and illustrations are accurate and add to the reader's understanding of the topic.	Diagrams and illustrations are neat and accurate and sometimes add to the reader's understanding of the topic.	Diagrams and illustrations are not accurate and do not add to the reader's understanding of the topic.

http://rubistar.4teachers.org/index.php

Drought in Georgia
Standards-Based Activities and Background Information
for Earth Science Teachers
Lesson 1
What is Drought?
Teacher Background Information

Depending on whom you ask, you will find multiple definitions for the term "drought." Droughts are not sudden catastrophic events like hurricanes and earthquakes. They take place over time, but they still cause economic stress and devastation. Imagine a farmer going several weeks without rain. To a farmer whose crops needed rain, that rainless period would be defined as a drought. A meteorologist looks at trends and normal conditions over time. The meteorologist compares years to years to years. Therefore, any period of time in which precipitation is less than normal could be called a "drought." For a water manager whose job is to provide water to businesses and homes, a drought is any deficiency in the water supply that affects water availability and water quality. Imagine a hydrologist whose work involves monitoring stream flow. Hydrologists study the distribution of water. They may research the flow or discharge of water along a river or over a dam. They often work as a team with other scientists. If a hydrologist notices a decrease in precipitation and stream flow over an extended period of time, he or she would consider that to be a drought situation. So, a person's perspective helps to define what a drought is.

During this lesson students will have the opportunity to look at a drought from multiple perspectives. Their own experiences with drought conditions will help them define what a drought is and what the term means to them.

Drought can occur anywhere. All droughts begin with a deficiency of precipitation, explains Don Wilhite of the National Drought Mitigation Center. He explains that droughts can be meteorological, agricultural and hydrological.

- Meteorological drought - can come and go as frequently, and as quickly, as rainstorms do and occurs when there is a precipitation deficiency compared to normal levels over time.
- Agricultural drought - is based on soil moisture levels in the top 24 or so inches of the soil where plants need it and where conditions change dramatically with one good rainstorm. Available soil moisture is the principal factor affecting plant growth and yield. Agricultural drought conditions reset every year.
- Hydrological drought - is much deeper and long-lasting than other forms of drought. Hydrological conditions (surface and groundwater levels and flows) are measured continuously, drought or not, so it cover a longer time period with no resetting.

Vocabulary

- **drought** - A drought is a period of drier than normal conditions that results in water-related problems. It is caused by a lack of precipitation at critical growing periods or may last long enough to affect hydrology (Moreland, 1993).

What is Drought?

Key Words: drought

Desired Outcomes

Goals:
S6E3. Students will recognize the significant role of water in earth processes.

a. Explain that a large portion of the Earth's surface is water, consisting of oceans, rivers, lakes, underground water, and ice.

Understandings: **Students will understand that…**	**Essential Questions:**
• a large portion of the Earth's surface is water, yet only a very small percentage of that water is available for consumption • a drought is a period of drier-than-normal conditions • droughts affect water supplies, agricultural production, stream water quality and habitat, recreation, navigation, and forest resources.	• What role does water play in earth processes? • What is drought? • What are some community impacts of drought?
Students will know…	**Students will be able to…**
• the significant role of water in earth processes • key vocabulary • how communities are affected by drought.	• discuss the significant role of water on Earth • operationally define drought from a number of perspectives • write about how drought might affect them and their community.

Lesson Hook:

- Show students the poster of the boy swinging over the dry riverbed. Have students look closely at the poster. Without talking to anyone, have students write down what is wrong with the picture. Then have them write what they think might have caused the situation in the picture. Have students pair up and then share their ideas with a classmate. Bring the class back together and discuss their ideas. Then, show students actual pictures of droughts found at http://www.drought.unl.edu/gallery/gallery.htm. Give each group of students a drought-related picture without any background information. Let the groups discuss and decide what might have caused the situation in the picture. Allow groups time to present their pictures and possible causes to the entire class.

Assessment

Performance Tasks:
News article
The town is experiencing a drought. We are not sure what effect the continuation of the drought will have on us as a community. Various experts in the field have concerns. Students will write interviews from the point of view of the experts.

You may choose to allow students to interview "experts" from Lesson 2, "Point of View."

To assist students in the writing process, you may want to have them find a title and get your approval before writing. You may also decide to brainstorm some possible titles first. Model expectations by sharing an example of a quality article and even an unacceptable article. Doing a class story together or providing a mini-workshop could be done for students who need extra help. Copies of the rubric should be given to the students and explained.

Other Evidence:
- Students' written responses upon first viewing the drought poster (lesson hook)
- Participation in group discussions
- Teacher observations

Plan of Action

Tasks:
Lesson 1: Setting the Stage: 15 Minutes

1. Write the word "drought" on the board. Tell the students that all of the pictures (see Lesson Hook) are the result of a drought. Explain to students that a large portion of the Earth's surface is water (oceans, rivers, lakes, underground water, ice). Place three glasses in the front of the room. Pour 97ml of water into the first glass. In the second glass, pour 2ml of water. In the third glass, pour 1ml of water. Explain to the class that the glasses combined represent all the water in the world. Have them guess which glass represents available usable water (the glass with 1ml). Identify the glass with 97ml as representing all the salt water in the world while the glass with 2ml represents the fresh water that is frozen in glaciers. Fresh water that is available for people to use as drinking water is a small percentage of all the water in the world. During times of drought, a greater percentage than normal of that available water is contained as a gas in the atmosphere instead of in liquid form where it

would become part of lakes, streams, rivers, and underground water sources that people could use.

Lesson 2: Point of View: 90 Minutes

1. Explain to students that the exact meaning of the word "drought" varies, depending on the point of view of the person explaining it. For example, a farmer might explain drought differently than a meteorologist, who might explain drought differently than a water manager, who might explain drought differently than a hydrologist.

2. Divide the class into groups of 4. Each group will represent one of the following roles: farmers, meteorologists, water managers, and hydrologists. Assign a role to each group and give each group the appropriate information card (**Student Activity Sheet #1**). Have students read the cards in the group and discuss. Students should research the role further and study together. Have students brainstorm and create a list of concerns regarding drought based on their assigned role.

3. Count off within each group and then pull all the 1's, 2's, 3's, and 4's from each group together to form new groups. Each group should now have a farmer, a meteorologist, a water manager, and a hydrologist expert in it.

4. Within the new groups, students will teach the other students in their group about their role. Students should compare and contrast the four perspectives on drought by asking and answering questions such as:
    - What is the farmer most concerned about the drought affecting?
    - How might the drought ultimately impact the farmer?
    - What has to occur for a meteorologist to consider it a time of drought?
    - What is the water manager most concerned about the drought affecting?
    - How is a hydrologist's point of view similar to that of the meteorologist? How is it different?

5. Then pull all the groups together to discuss the elements that the points of view have in common, and work with the students to develop a general definition of drought. The share this definition with the class: "drought is a period of drier than normal conditions that results in water-related problems (Moreland, 1993)." Compare this definition with the one the class wrote.

6. Ask students the following questions:
    a. What is their point of view on drought?
    b. Can drought affect them?
    c. Share examples of how drought affects them.

d. What personal experiences have they had with drought?
e. Are they aware of any historically significant drought situations?

Lesson 3: In the News: 90 Minutes In Class/ 45 Minutes Homework

1. Ask students to write a brief news article about how drought might affect them and their community. Tell them that the town is experiencing a drought. We are not sure what effect the continuation of the drought will have on us as a community. Various experts in the field have concerns. Students will write interviews from the point of view of the experts. Students may choose to interview "experts" from Lesson 2, "Point of View." Provide the photos of drought from the lesson hook activity. Allow students to use those photos as a reference for their own illustration/diagram. Provide students with a copy of the rubric and discuss expectations before students begin to write (**Student Activity Sheet #2**).

2. Conclude by having students share their articles with the class. This can be done orally in small groups or as a whole class presentation.

Additional Resources:

Websites:

- http://ga.water.usgs.gov/edu/qadroughts.html#drought
- http://www.drought.unl.edu/gallery/gallery.htm
- http://drought.unl.edu/kids/index.htm

Books for Teachers

- The Watercourse. (1999). *Project Wet.* Bozeman: Montanna.

Books for Students

- Stanley, Jerry. (1992). *Children of the Dustbowl: The True Story of the School at Weedpatch Camp.* New York, NY: Crown.

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Perspective Cards
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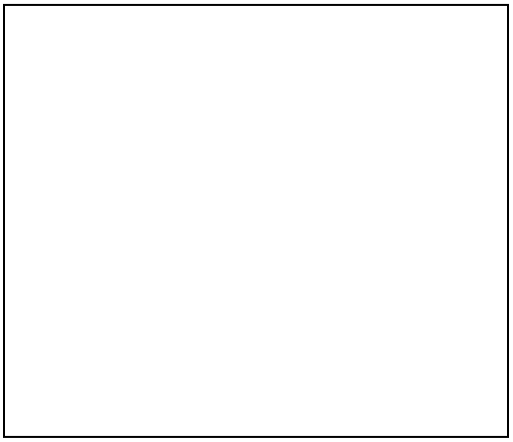

Student Activity Sheet #2
What is Drought?
In the News! Rubric

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http://rubistar.4teachers.org/index.php

Student Activity Research Sheet #1
The Cause and Effects of Drought
Who Shut Off My Water?

Introduction and Review

1. Review the w*ater cycle* through research. In your research team look at the Web site below and review the diagram of the water cycle and the water cycle words. Discuss the meaning of the words as a group. In the space below draw your own water cycle using as many water cycle words as possible. You should use at least 8 water cycle words in your diagram.

Draw your water cycle diagram here:

Water Science for Schools: The Water Cycle
http://ga.water.usgs.gov/edu/watercycle.html

2. What causes a drought? In your research team, look at the Web sites given below and read the information on the causes of drought. Decide as a group what it is that causes a drought. Take notes and then write an explanation of the cause/s of drought in the space provided on this worksheet.

DRBC – Drought Information for Kids
http://www.state.nj.us/drbc/drought/kids_droughtinfo.htm

Drought: A Paleo Perspective – What is drought?
http://www.ncdc.noaa.gov/paleo/drought/drght_what.html

Student Activity Sheet #2
The Cause and Effects of Drought
Who Shut Off My Water?

Student Map Worksheet - Reading National Weather Service and Drought Monitoring Maps

Rainfall and Distribution of Water

Use your Georgia map to record information

1. What is Georgia's average **annual rainfall?** Annual rainfall is the measured amount of rain that falls in an area in a year (see your vocabulary definition). You are going to determine what the annual rainfall is for some of Georgia's cities and record this on your Georgia map that is provided. First you will need to locate these cities on your Georgia map and write them down. The cities are: **Albany, Atlanta, Augusta, Columbus, Macon, Rome and Savannah.** You may need to find a political map of Georgia to locate these cities. Once the cities are on your Georgia map in the proper location your research team will need to go to the National Weather Service site below and it will open to Georgia's Average Annual Rainfall Map. You will notice that the map is full of color and the colors have a meaning. Different colors designate different rainfall amounts and you will be able to get those amounts by looking at the legend provided. You will want to look at the area on the annual rainfall map where the city is located and see what color is in that area. The color will let you know the annual rainfall inches and you will record that number next to the city and write down AR for annual rainfall next to the number on your Georgia map. For example, if the color is dark brown where your city is located, the average annual rainfall is under 46 inches. You write down *under 46 inches AR* next to the city name.

National Weather Service Forecast
http://www.srh.noaa.gov/ffc/images/gapcph7.gif
Open the section – Georgia's Average Annual Rainfall Map

Drought Severity

Use your United States map to record information

2. Investigate the most up-to-date U.S. Drought Monitor Map using the Web site below. This map gives you a way to look at the intensity or the severity of a drought in a particular part of the country. For each bullet you will be asked to color in one or more areas on your US map, label the drought intensity and date your work. The Drought Monitor Map is accurate for this date in time. You will also notice by the color-coded legend that droughts can be more or less intense depending on where and when they occur and their duration. Find Georgia on your United States map. Does Georgia have any color on the U.S. Drought Monitor Map?

- Using markers, copy the same colors in the same locations on your United States map in the state of Georgia. Label the colors with the

intensity designated by the color legend. For example, if you colored an area of Georgia yellow, it means abnormally dry. You would write in "abnormally dry" by that area and write the date of your research.

- What colors do you see in the states that border Georgia? Use crayons or markers and copy the colors on your U.S. map in the states that border Georgia. Label the intensity of drought for each colored area in the states. Be sure to date your research.

- Look at the U.S. Drought Monitor Map and see if you can find a state or part of a state that has a **moderate** drought at present. Color that state and area with the appropriate color and label the type of drought **moderate.** Add the current date on the map next to each researched drought.

- Looking at the U.S. Drought Monitor Map, can you see a state or part of a state experiencing a **severe** drought at this time? If so, color that state and area in on your U.S. map with the appropriate color. Label the intensity of the drought and date your research.

- According to the U.S. Drought Monitor Map, is any state experiencing an **exceptional** drought at present? Color in an area of a state experiencing **exceptional** drought if you were able to locate one and label the type of drought **exceptional** on your U.S. map. Date your research.

- How would you know if a state has an **agricultural** drought occurring? On your U.S. Drought Monitor Map, can you find a state that has **agricultural** drought occurring? Put the appropriate symbol in that state on your U.S. map to designate agricultural drought. Check your map legend.

- Check your U.S. Drought Monitor Map again to see if a state has **hydrological** drought occurring. If so, put an **H** on your U.S. map in the state that is experiencing **hydrological** drought.

US Drought Monitor
http://www.drought.unl.edu/dm/monitor.html

Student Activity Sheet #3
The Cause and Effects of Drought
Who Shut Off My Water?

Looking at the Effects of Drought in Georgia and Australia

Use your Georgia map to record information

1. How have droughts affected crops in Georgia?

Working in research teams use the Web sites below to learn how drought affects crops in Georgia. If you have time and your teacher approves, you can look at other sites to find additional information. You will use your Georgia map and record your notes there. If the article provides a geographic location, you will put your notes in the appropriate place on your Georgia map. For example, if you discover that pecan production was affected in southwest Georgia and that only one third of the crops were saved, you would write southwest Georgia on the Georgia map. Your notes would say that pecan crops are affected and one third crop losses occurred. Include the date of the article on your map. You will need to find 2 sources of information to include on your Georgia map for each question.

Dry conditions have an effect on GA's number one industry, says Agriculture Commissioner Tommy Irvin
http://agr.georgia.gov/00/article/0,2086,38902732_39653527_57253823,00.html
(Go to the Press Releases. List title of the article in the search box.)

Georgia Economic Losses due to the drought of 2006
http://www.caed.uga.edu/publications/2006/pdf/CR-06-06A.pdf

Drought Hits Farmer's Wallets Hard
http://georgiafaces.caes.uga.edu/getstory.cfm?storyid=985

Drought Reduces Georgia's 2006 Pecan Production
http://www.geocities.com/CollegePark/Campus/3370/DroughtReducesGa06PecanProduction.htm

2. How has livestock been impacted by droughts in Georgia?

In your research group, look at the following websites and find information that will tell you how livestock is affected during a drought. You will need to find at least 2 sources and write the notes on your Georgia map. If the articles give you a geographic location please put your notes in that location on your Georgia map.

Caring for Dairy Cows in Hot Weather
http://interests.caes.uga.edu/drought/content/dairydry.htm

Livestock Assistance Grant Program/Frequently Asked Questions
http://agr.georgia.gov/vgn/images/portal/cit_1210/26/4/73085159Q%20&%20A%20LAG%20sheet.doc

3. How does drought affect plants and trees in Georgia?

Your research team can use the following Web sites to find information on how trees and plants are affected by drought. You will need to find 2 sources and put the information in note form on your Georgia map and date it.

Drought Information for Kids
http://www.state.nj.us/drbc/drought/kids_droughtinfo.htm

Drought and Flooding
http://www.forestpests.org/gfcbook/droughtflooding.html

Effects on Trees – Thirsty Trees
http://www.georgiamagazine.org/archives_view.asp?mon=11&yr=2006&ID=1450

4. Have there been any impacts on stream flows or lake levels in recent droughts in Georgia?

Your research team will look for information about hydrological drought because that affects stream flows and lake levels. Record your notes on your Georgia map with the date. You will need to find at least 2 sources.

Droughts in Georgia
http://ga.water.usgs.gov/publications/ofr00-380.pdf

Protecting Georgia's Surface Water
The University of Georgia College of Agriculture and Environmental Sciences
http://pubs.caes.uga.edu/caespubs/pubcd/B1217.htm

5. What evidence is there of wildlife being affected by Georgia droughts?

Research the Web sites below, and others if time allows, to discover how wildlife is affected during a drought. Record your 2 sources on your Georgia map and add the date of the articles.

Mussel and other aquatic species impacts
http://www.jonesctr.org/research/aquatics_research/final_report.pdf
http://www.ens-newswire.com/ens/jul2002/2002-07-19-09.asp

Striped Bass Survival in Lake Blackshear
http://www.Springerlink.com/content/m5645n4573381g30/
Georgia Drought Brings Alligators Together
http://animals.about.com/b/a/256914.htm

Georgia/USA and New South Wales/Australia drought comparison

6. Using the Georgia and New South Wales maps, compare these two states in population, land size, and latitude and longitude. Record the information on the Georgia and New South Wales maps provided. Record the information on population on the Georgia map and on the New South Wales map. Write in the land size for Georgia and the land size for New South Wales. Give the latitude and longitude for each state and record it on the appropriate map.

For Georgia, New South Wales geographic information see:
http://www.worldatlas.com/webimage/countrys/namerica/usstates/ga.htm

7. Use the following Web sites and read the following articles on drought in New South Wales, Australia. Record the data on your New South Wales map. Below are some Web sites to get you started. You will need to provide information from at least 3 sources on your New South Wales map. Just take brief notes of the main point in the articles.

Australia drought could impact dairy prices
http://www.dairyreporter.com/news/ng.asp?id=71475
Australia drought could be worst in 1,000 years
http://www.msnbc.msn.com//id/15625626/
Drought in Australia – Nov 12
http://www.energybulletin.net/22268.html
Parched in Australia: Drought changes views on warming
http://www.iht.com/articles/2006/11/07/news/drought.php
MWC News – A Site Without Borders – Australia's battle with drought
http://mwcnews.net/content/view/11677&Itemid+1
***Drought hits wholesale*, retails sectors**
http://www.abc.net.au/news/newsitems/200701/s1823661.htm
Nationals highlight drought's impact on regional education
http://www.abc.net.au/news/newsitems/200701/s1823837.htm

8. Write a paragraph comparing the effects of the 2006 drought in Georgia to the 2006/07 drought in New South Wales. Please list two similarities and two differences. According to your research, do you think the drought in New South Wales is more or less severe than the drought in Georgia?

Additional websites:
http://ga.water.usgs.gov/news/drought99/photos/index.html

http://drought.unl.edu/kids/reduce/awareness.htm

www.drought.noaa.gov/

http://gpc.edu/~pgore/Earth&Space/GPS/GPScontents.html

Teacher/Student Checklist for Research Assessment
Lesson 2 Cause and Effects

Student_____

Total Points

1. **Anticipation Guide** No attempt to fill in (2 pts.) or attempt to draw a picture of drought and have a cause and effect. (5 pts.) 5 point total _____

2. **Water cycle diagram** 8 or more water cycle words in their correct places (8 pts.) 5-7 water cycle words (6 pts.) or less than 5 (4 pts.) 8 point total Worksheet #1 _____

3. **Cause of drought** well written (2 pts.) _____
(See teacher background) Worksheet #1 2 point total

4. **Annual Rainfall Map** Students have placed all 7 cities in the correct geographic location on the Georgia map (7pts.) students have researched and recorded annual rainfall for the 7 cities (7 pts.) 14 point total Georgia map _____

5. **Drought Severity – U.S. Drought Monitor Map** Students have colored in the drought severity for Georgia (2pts.), students have used the color legend and colored in the border states' drought severity information (2 pts.), student have found a state with moderate drought, (2pts) a state with severe drought (2pts.) and a state with exceptional drought (2 pts.), a state with agricultural drought, (2pts.) and hydrological drought (2 pts.) 14 point total U.S. Map _____

6. **Drought in Georgia – Effects** Students will research and record 2 Web sites and 2 effects of drought for questions 1-5 on Worksheet # 3 that includes crops, livestock, plants and trees, stream flows and lake levels, and wildlife. Students receive 2 pts. for each Web site and 2 pts. for each effect found. They have been asked to find at least 2 Web sites and 2 effects for each topic. 20 point total Georgia map (students can earn extra pts.) _____

7. **Comparing Georgia and New South Wales** Students will Compare these 2 states in population, (3 pts.) land size (3 pts.) and latitude and longitude (3 pts.) using their Georgia and New South Wales maps. 9 point total _____

8. **Learning about drought in Australia** Students will need to record drought information from at least 3 Web sites on their New South Wales map. (2 pts. each) 12 point total _____

9. **Written Comparison Paragraph on Drought** Students have been asked to write a paragraph comparing the drought in Georgia to the drought in New South Wales and provide 2 similarities and 2 differences. 10 point total

_____

10. **Anticipation Guide** The Anticipation Guide is now given to students to fill out having the advantage of their research. Students should be able to give 3 effects of drought at 2 pts. each – 6 pt. total Anticipation Guide _____

100 point total **Research Total points** _____

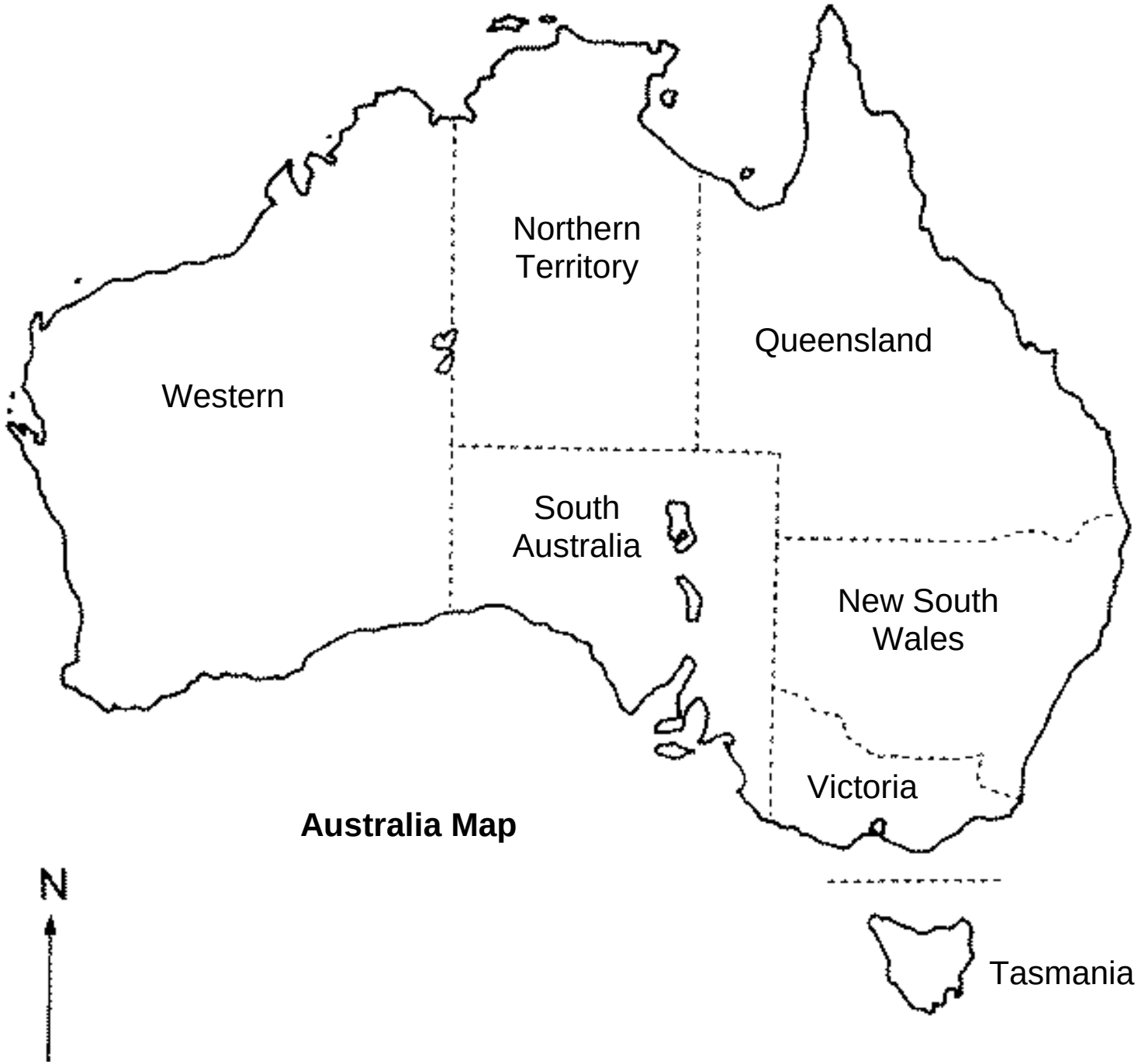
Who Shut Off My Water
Cause and Effects

USA Map

Georgia Map

New South Wales Australia Map

Who Shut Off My Water
Cause and Effects



Australia Map

Anticipation Guide

Causes

Effects

Draw a picture of drought here.

Who Shut Off My Water
Cause and Effects

Drought in Georgia
Standards-Based Activities and Background Information
for Earth Science Teachers
Lesson 2
Cause and Effects of Drought
Who Shut Off My Water?

Drier than normal conditions over time or at critical growing periods that result in water-related problems are the **cause** of drought. These problems produce a **variety of effects** that occur from water that is not distributed evenly throughout our world. Precipitation (rain or snow) falls in uneven patterns across the country. The amount of precipitation at a particular location varies from year to year, but over a period of years, the average amount is fairly constant. In the deserts of the Southwest, the average precipitation is less than 3 inches per year. In contrast, the average yearly precipitation in Atlanta, Georgia is about 50 inches.

The amount of rain and snow also varies with the seasons. In Georgia, for example, most of the yearly precipitation falls during winter, early spring, and in July. Even if the total amount of rainfall for a year is about average, short-term rainfall shortages can occur when moisture is critically needed for plant growth, such as in the early summer for crops like peanuts and cotton. When this happens, the **effect** is agricultural drought and can affect farmers in many ways. Farmers can be affected through crop losses, livestock reductions and, of course, economic losses that result from reduced crop yields and business services.

When rainfall is less than normal for several weeks, months, or years the **effect** can be hydrological drought. The flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth of water in wells decreases. If dry weather persists water supply for human consumption can then become a problem. Drought is a natural hazard that cumulatively has affected more people in North America than any other natural hazard (Riebsame et al, 1991). The cost of losses due to drought in the United States averages $6-8 billion every year but ranges as high as $39 billion. The three-year drought of 1987-1989, was the most costly natural disaster documented in U.S. history.
http://www/ncdc.noaa.gov/paleo/drought/drght_history.html

Droughts in Georgia have severely affected municipal and industrial water supplies, agricultural productivity, stream and water quality, recreation at major reservoirs, habitat, hydropower generation, navigation, and forest resources.
http://ga.water.usgs.gov/edu/qadroughts.html#drought

Please note: Web sites cited in this document were accessible as of February 2007.

Vocabulary Definitions:

- **affect –** (v) act physically on; have an effect upon
- **agriculture** - the science, art, and business of cultivating soil, producing crops and raising livestock; farming
- **annual rainfall** – the measured amount of rain that falls in an area in a year. It is usually referred to as the average (a statistic describing the location of a distribution) annual rainfall.
- **drought** – (n) a period of drier than normal conditions that results in water-related problems. It is caused by a lack of precipitation at critical growing periods or may last long enough to affect hydrology.
- (adj.) We are experiencing **drought** conditions.
- **drought severity** - the duration and intensity of the drought: usually measured using the Palmer Hydrological Drought Index http://lwf.ncdc.noaa.gov/oa/climate/research/prelim/drought/palmer.html
- **effect -** something brought about by a cause or agent; a result
  The power to produce an outcome or achieve a result; influence
- **hydrology** - the study of the waters of the earth, especially with relation to the effects of precipitation and evaporation upon the occurrence and character of water in streams, lakes, and on or below the land surface
- **meteorology -** the science that deals with the phenomena of the atmosphere, especially weather and weather conditions
- **precipitation -** any and all forms of water, liquid or solid, that fall from clouds and reach the ground. This includes drizzle *(*fairly uniform precipitation composed exclusively of fine drops of water, less than 0.5 mm diameter, very close to one another; the effect of their individual impact on water surfaces is imperceptible), freezing drizzle, freezing rain, hail, ice crystals, ice pellets, rain, snow, snow pellets, and snow grains. The amount of fall is usually expressed in inches of liquid water depth of the substance that has fallen at a given point over a specified time period.

Who Shut Off My Water?
Cause and Effects of Drought

Key Words: affect, agriculture, annual rainfall, drought, effect, hydrology, meteorology, precipitation, severity (drought)

Desired Outcomes

Goals: S6E3. Students will recognize the significant role of water in earth processes.

b. Relate various stages of the atmospheric conditions to stages of the water cycle.

S6CS6. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

a. Observe and explain how parts are related to other parts in systems such as weather systems, solar systems, and ocean systems including how the output from one part of a system (in the form of material, energy, or information) can become the input to other parts.

S6CS6. Students will communicate scientific ideas and activities clearly.

b. Organize scientific information using appropriate tables, charts, and graphs, and identify relationships they reveal.

S6CS7. Students will question scientific claims and arguments effectively.

c. Recognize that there may be more than one way to interpret a given set of findings.

S6CS9. Students will investigate the features of the process of scientific inquiry

d. Scientists use technology and mathematics to enhance the process of scientific inquiry.

S6CS10. Students will enhance reading in all curriculum areas by:

b. Building vocabulary knowledge

- Use content knowledge vocabulary in writing and speaking.

SS6G10. The student will discuss the impact of government policies and individual behaviors on the environments of Australia and Oceania.

a. Explain major environmental concerns Australians have regarding issues such as protection of The Great Barrier Reef, Ozone depletion, and global warming and actions taken by the government and/or citizens regarding these concerns.

SS6G11. The student will explain the impact of location, climate, physical characteristics, natural resources and population size on Australia and Oceania.

a. Describe how Australia's location, climate, and natural resources have

affected where people live, where agricultural and industrial regions are located, and on trade, especially the importance of deserts, the river system and the many good harbors.

Understandings: **Students will understand that…**	**Essential Questions:**
• the water cycle is a cycle of evaporation and condensation and precipitation that controls the distribution of Earth's water • drought is caused by a lack of precipitation at critical growing periods or may last long enough to affect hydrology • water is not distributed evenly throughout the world. • droughts can have different severity levels • drought has effects on agriculture, stream flow and lake levels, plants, animals, and the economy • drought affects everyone - Georgia, other states, continents and cultures differently. • drought affects different users, geographic regions and cultures differently.	• How does water move through the water cycle? • What causes a drought? • How evenly is water distributed throughout the world? • How can you determine the severity level of drought? • What are the effects of drought? • How does drought in Georgia compare to drought in Australia?
Students will know…	**Students will be able to…**
• how water moves through the water cycle • that drought is caused by a lack of precipitation over time that can affect crop losses, or be severe enough to affect stream flow, lake levels and water supply • that water is not distributed evenly throughout the world • that there are different severity levels of drought that states experience • that Georgia crops, livestock, plants, stream flow and lake levels, economy, and wildlife are	• write what they know about drought and the causes and effects before they do their research using *The Anticipation Guide* • draw and articulate the water cycle • research the cause of drought • use the Georgia Annual Rainfall Map to determine annual rainfall for major cities in Georgia • use the U.S. Drought Monitor Map to determine drought severity in Georgia and in other states • research Web sites to discover

affected during Georgia drought • that drought in Australia has similarities and differences compared to drought in Georgia.	the causes and effects of drought in Georgia and drought in New South Wales, Australia • map their research data by filling in the information found on their U.S. map, Georgia map and their New South Wales map • Write out causes and effects of Georgia drought in their *Anticipation Guide* using their research. .

Lesson Hook: Students will receive *The Anticipation Guide* to express what they know about the causes and effects of drought. Students will draw a picture of drought and state causes and effects prior to doing their research.

Assessment

Performance Tasks
Student Activity Worksheet #1
The Cause and Effects of Drought

Introduction and Review

Water Cycle
Students will review the water cycle through Web site research and discuss the water cycle as a team. Each student will draw the water cycle individually on his/her worksheet. The water cycle should include at least 8 water cycle terms such as transpiration, condensation, precipitation, evaporation, ground water, infiltration, stream flow, ocean storage.

Cause of Drought
Students will research the cause of drought and should have a written definition such as:
Drought is caused by a lack of rain over time that can affect agriculture and hydrology.

Student Activity Worksheet #2
The Cause and Effects of Drought
Reading National Weather Service and Drought Monitoring Maps

Rainfall and Distribution of Water

Georgia Annual Rainfall Map
On the annual rainfall map of Georgia, students should fill in annual rainfall

amounts for 7 major Georgia cities: Atlanta, Macon, Rome, Columbus, Savannah, Albany and Augusta. Students can find the information needed on the annual rainfall map at the National Weather Service Web site listed on the worksheet. Students should use the color and inches legend on the map to fill in annual rainfall for the 7 Georgia cities.

Drought Severity

U.S. Drought Monitor Map
The drought monitor map will require students to color in their U.S. map with various colors that indicate current drought severity levels. Through research, students will use the legend to determine drought severity in various states and record the appropriate color for the intensity of the drought. Students should be able to complete all 7 questions and record their answers on the U.S. map.

Student Activity Worksheet #3
The Cause and Effects of Drought

Looking at the Effects of Drought in Georgia and Australia

Georgia/Australia Drought – Cause and Effects Worksheet
On this worksheet, students will look at causes and effects of drought in Georgia and Australia on agriculture, livestock, plants, stream flows and wildlife. They should locate at least 2 Web sites and effects for each question 1-5 on the *Causes and Effects Worksheet* and transfer these effects to the Georgia map. Students should be able to find at least 3 effects for the drought in New South Wales and fill that out on the New South Wales map. Students should be able to write a paragraph that compares drought in Georgia to drought in New South Wales that includes at least 2 similarities and 2 differences. Students' maps will be assessed for the quality of work and the number of causes and effects researched.

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Other Evidence: Students will fill out their *Anticipation Guide* again at the conclusion of the activity.

Plan of Action

Learning Tasks:

1. Hand out *The Anticipation Guide* and ask students to fill it out. Point out to the students that they are to draw a picture of drought in the center of the guide and fill in as many causes and effects of drought as they can name in the appropriate places. This is not a test but rather a way for students to see what they know and then what they learn after research on drought. Students will refer back to their *Anticipation Guide* at the end of the activity and fill it out again to realize what they have learned about cause and effects of drought. (15 min.)

   Student Activity Worksheet #1
   Introduction and Review
2. Organize students in research groups according to computer availability. Each student should complete his/her own maps and worksheets with recorded data.
3. Give students worksheet #1. Research teams will review the water cycle using the Web sites provided. As a group they will discuss the water cycle. Students will individually draw a diagram of the water cycle on their worksheets. (20 min.)
4. Students will also research the cause of drought as review and write the cause of drought on student activity worksheet #1. (10 min.)

   Student Activity Worksheet #2
   Rainfall and Distribution of Water
5. Give students worksheet #2. Students will determine the annual rainfall for 7 major Georgia cities using the Georgia Average Annual Rainfall Map from the National Weather Service. (Use the Web site given) The map has a legend with color coding that relates to the annual number of inches for that area. Remind students that it will be necessary for them to locate the 7 cities on their Georgia map. They will need to look at a political map of Georgia to see where these cities should be located. Students will need to record the cities and the annual rainfall on their Georgia map. (20 min.)

   Drought Severity
6. Worksheet #2 - This activity will require crayons or markers so that students can color in the correct colors that represent drought intensity. Students will have an opportunity to investigate the severity of drought across the country by using the U.S. Drought Monitor from the National Drought Mitigation Center and record them on their U.S. map. There is a color legend that relates to drought severity and students will use this to answer questions and record on their U.S. map. They will copy the colors on their U.S. map. Students will learn whether the drought is mild, moderate, severe or exceptional, and they will learn whether the drought is agricultural or hydrological. (20 min.)

   Student Activity Worksheet #3
   Looking at the Effects of Drought in Georgia and Australia
7. Students will research the cause and effects of drought in Georgia and Australia using available research articles from Web sites provided and any they find on their own using the Student Activity Worksheet #3. Questions 1-5 are to be recorded on the Georgia map provided. (30 min.) Students should be able to record answers from at least 2 different Web

sites per question.

8. Questions 6-8 compare and contrast current drought in Georgia to drought in Australia. Students will be asked to learn about Georgia as a State compared to New South Wales as a state in terms of land size, longitude and latitude, and population size. They will record this information on their Georgia and New South Wales maps. They will research Web sites that will give them an idea about drought in Australia and they must record information from at least 3 sites on their New South Wales map. (30 min.)
9. Students will be asked to write a paragraph comparing drought in Georgia, a state on the continent of North America, and New South Wales, a state on the continent of Australia. Students will present their research through their created maps. They will need to write similarities and two differences (30/40 min.)
10. Students will discover what they learned about the cause and effects of drought by filling out their *Anticipation Guide* again after their research. (15 min.)

Additional Resources:

http://ga.water.usgs.gov/news/drought99/photos/index.html

http://drought.unl.edu/kids/reduce/awareness.htm

www.drought.noaa.gov/

http://gpc.edu/~pgore/Earth&Space/GPS/GPScontents.html

Student Activity Research Sheet #1
The Cause and Effects of Drought
Who Shut Off My Water?

Introduction and Review

1. Review the w*ater cycle* through research. In your research team look at the Web site below and review the diagram of the water cycle and the water cycle words. Discuss the meaning of the words as a group. In the space below draw your own water cycle using as many water cycle words as possible. You should use at least 8 water cycle words in your diagram.

Draw your water cycle diagram here:

Water Science for Schools: The Water Cycle
http://ga.water.usgs.gov/edu/watercycle.html

2. What causes a drought? In your research team, look at the Web sites given below and read the information on the causes of drought. Decide as a group what it is that causes a drought. Take notes and then write an explanation of the cause/s of drought in the space provided on this worksheet.

DRBC – Drought Information for Kids
http://www.state.nj.us/drbc/drought/kids_droughtinfo.htm

Drought: A Paleo Perspective – What is drought?
http://www.ncdc.noaa.gov/paleo/drought/drght_what.html

Student Activity Sheet #2
The Cause and Effects of Drought
Who Shut Off My Water?

Student Map Worksheet - Reading National Weather Service and Drought Monitoring Maps

Rainfall and Distribution of Water

Use your Georgia map to record information

1. What is Georgia's average **annual rainfall?** Annual rainfall is the measured amount of rain that falls in an area in a year (see your vocabulary definition). You are going to determine what the annual rainfall is for some of Georgia's cities and record this on your Georgia map that is provided. First you will need to locate these cities on your Georgia map and write them down. The cities are: **Albany, Atlanta, Augusta, Columbus, Macon, Rome and Savannah.** You may need to find a political map of Georgia to locate these cities. Once the cities are on your Georgia map in the proper location your research team will need to go to the National Weather Service site below and it will open to Georgia's Average Annual Rainfall Map. You will notice that the map is full of color and the colors have a meaning. Different colors designate different rainfall amounts and you will be able to get those amounts by looking at the legend provided. You will want to look at the area on the annual rainfall map where the city is located and see what color is in that area. The color will let you know the annual rainfall inches and you will record that number next to the city and write down AR for annual rainfall next to the number on your Georgia map. For example, if the color is dark brown where your city is located, the average annual rainfall is under 46 inches. You write down *under 46 inches AR* next to the city name.

National Weather Service Forecast
http://www.srh.noaa.gov/ffc/images/gapcph7.gif
Open the section – Georgia's Average Annual Rainfall Map

Drought Severity

Use your United States map to record information

2. Investigate the most up-to-date U.S. Drought Monitor Map using the Web site below. This map gives you a way to look at the intensity or the severity of a drought in a particular part of the country. For each bullet you will be asked to color in one or more areas on your US map, label the drought intensity and date your work. The Drought Monitor Map is accurate for this date in time. You will also notice by the color-coded legend that droughts can be more or less intense depending on where and when they occur and their duration. Find Georgia on your United States map. Does Georgia have any color on the U.S. Drought Monitor Map?

- Using markers, copy the same colors in the same locations on your United States map in the state of Georgia. Label the colors with the intensity designated by the color legend. For example, if you colored an area of Georgia yellow, it means abnormally dry. You would write in "abnormally dry" by that area and write the date of your research.

- What colors do you see in the states that border Georgia? Use crayons or markers and copy the colors on your U.S. map in the states that border Georgia. Label the intensity of drought for each colored area in the states. Be sure to date your research.

- Look at the U.S. Drought Monitor Map and see if you can find a state or part of a state that has a **moderate** drought at present. Color that state and area with the appropriate color and label the type of drought **moderate.** Add the current date on the map next to each researched drought.

- Looking at the U.S. Drought Monitor Map, can you see a state or part of a state experiencing a **severe** drought at this time? If so, color that state and area in on your U.S. map with the appropriate color. Label the intensity of the drought and date your research.

- According to the U.S. Drought Monitor Map, is any state experiencing an **exceptional** drought at present? Color in an area of a state experiencing **exceptional** drought if you were able to locate one and label the type of drought **exceptional** on your U.S. map. Date your research.

- How would you know if a state has an **agricultural** drought occurring? On your U.S. Drought Monitor Map, can you find a state that has **agricultural** drought occurring? Put the appropriate symbol in that state on your U.S. map to designate agricultural drought. Check your map legend.

- Check your U.S. Drought Monitor Map again to see if a state has **hydrological** drought occurring. If so, put an **H** on your U.S. map in the state that is experiencing **hydrological** drought.

US Drought Monitor
http://www.drought.unl.edu/dm/monitor.html

Student Activity Sheet #3
The Cause and Effects of Drought
Who Shut Off My Water?

Looking at the Effects of Drought in Georgia and Australia

Use your Georgia map to record information

1. How have droughts affected crops in Georgia?

Working in research teams use the Web sites below to learn how drought affects crops in Georgia. If you have time and your teacher approves, you can look at other sites to find additional information. You will use your Georgia map and record your notes there. If the article provides a geographic location, you will put your notes in the appropriate place on your Georgia map. For example, if you discover that pecan production was affected in southwest Georgia and that only one third of the crops were saved, you would write southwest Georgia on the Georgia map. Your notes would say that pecan crops are affected and one third crop losses occurred. Include the date of the article on your map. You will need to find 2 sources of information to include on your Georgia map for each question.

Dry conditions have an effect on GA's number one industry, says Agriculture Commissioner Tommy Irvin
http://agr.georgia.gov/00/article/0,2086,38902732_39653527_57253823,00.html
(Go to the Press Releases. List title of the article in the search box.)

Georgia Economic Losses due to the drought of 2006
http://www.caed.uga.edu/publications/2006/pdf/CR-06-06A.pdf

Drought Hits Farmer's Wallets Hard
http://georgiafaces.caes.uga.edu/getstory.cfm?storyid=985

Drought Reduces Georgia's 2006 Pecan Production
http://www.geocities.com/CollegePark/Campus/3370/DroughtReducesGa06PecanProduction.htm

2. How has livestock been impacted by droughts in Georgia?

In your research group, look at the following websites and find information that will tell you how livestock is affected during a drought. You will need to find at least 2 sources and write the notes on your Georgia map. If the articles give you a geographic location please put your notes in that location on your Georgia map.

Caring for Dairy Cows in Hot Weather
http://interests.caes.uga.edu/drought/content/dairydry.htm

Livestock Assistance Grant Program/Frequently Asked Questions
http://agr.georgia.gov/vgn/images/portal/cit_1210/26/4/73085159Q%20&%20A%20LAG%20sheet.doc

3. How does drought affect plants and trees in Georgia?

Your research team can use the following Web sites to find information on how trees and plants are affected by drought. You will need to find 2 sources and put the information in note form on your Georgia map and date it.

Drought Information for Kids
http://www.state.nj.us/drbc/drought/kids_droughtinfo.htm

Drought and Flooding
http://www.forestpests.org/gfcbook/droughtflooding.html

Effects on Trees – Thirsty Trees
http://www.georgiamagazine.org/archives_view.asp?mon=11&yr=2006&ID=1450

4. Have there been any impacts on stream flows or lake levels in recent droughts in Georgia?

Your research team will look for information about hydrological drought because that affects stream flows and lake levels. Record your notes on your Georgia map with the date. You will need to find at least 2 sources.

Droughts in Georgia
http://ga.water.usgs.gov/publications/ofr00-380.pdf

Protecting Georgia's Surface Water
The University of Georgia College of Agriculture and Environmental Sciences
http://pubs.caes.uga.edu/caespubs/pubcd/B1217.htm

5. What evidence is there of wildlife being affected by Georgia droughts?

Research the Web sites below, and others if time allows, to discover how wildlife is affected during a drought. Record your 2 sources on your Georgia map and add the date of the articles.

Mussel and other aquatic species impacts
http://www.jonesctr.org/research/aquatics_research/final_report.pdf
http://www.ens-newswire.com/ens/jul2002/2002-07-19-09.asp

Striped Bass Survival in Lake Blackshear
http://www.Springerlink.com/content/m5645n4573381g30/

Georgia Drought Brings Alligators Together
http://animals.about.com/b/a/256914.htm

Georgia/USA and New South Wales/Australia drought comparison

6. Using the Georgia and New South Wales maps, compare these two states in population, land size, and latitude and longitude. Record the information on the Georgia and New South Wales maps provided. Record the information on population on the Georgia map and on the New South Wales map. Write in the land size for Georgia and the land size for New South Wales. Give the latitude and longitude for each state and record it on the appropriate map.

For Georgia, New South Wales geographic information see:
http://www.worldatlas.com/webimage/countrys/namerica/usstates/ga.htm

7. Use the following Web sites and read the following articles on drought in New South Wales, Australia. Record the data on your New South Wales map. Below are some Web sites to get you started. You will need to provide information from at least 3 sources on your New South Wales map. Just take brief notes of the main point in the articles.

Australia drought could impact dairy prices
http://www.dairyreporter.com/news/ng.asp?id=71475
Australia drought could be worst in 1,000 years
http://www.msnbc.msn.com//id/15625626/
Drought in Australia – Nov 12
http://www.energybulletin.net/22268.html
Parched in Australia: Drought changes views on warming
http://www.iht.com/articles/2006/11/07/news/drought.php
MWC News – A Site Without Borders – Australia's battle with drought
http://mwcnews.net/content/view/11677&Itemid+1
***Drought hits wholesale*, retails sectors**
http://www.abc.net.au/news/newsitems/200701/s1823661.htm
Nationals highlight drought's impact on regional education
http://www.abc.net.au/news/newsitems/200701/s1823837.htm

8. Write a paragraph comparing the effects of the 2006 drought in Georgia to the 2006/07 drought in New South Wales. Please list two similarities and two differences. According to your research, do you think the drought in New South Wales is more or less severe than the drought in Georgia?

Additional websites:
http://ga.water.usgs.gov/news/drought99/photos/index.html

http://drought.unl.edu/kids/reduce/awareness.htm

www.drought.noaa.gov/

http://gpc.edu/~pgore/Earth&Space/GPS/GPScontents.html

Teacher/Student Checklist for Research Assessment
Lesson 2 Cause and Effects

Student_____

Total Points

1. **Anticipation Guide** No attempt to fill in (2 pts.) or attempt to draw a picture of drought and have a cause and effect. (5 pts.) 5 point total _____

2. **Water cycle diagram** 8 or more water cycle words in their correct places (8 pts.) 5-7 water cycle words (6 pts.) or less than 5 (4 pts.) 8 point total Worksheet #1 _____

3. **Cause of drought** well written (2 pts.) _____
(See teacher background) Worksheet #1 2 point total

4. **Annual Rainfall Map** Students have placed all 7 cities in the correct geographic location on the Georgia map (7pts.) students have researched and recorded annual rainfall for the 7 cities (7 pts.) 14 point total Georgia map _____

5. **Drought Severity – U.S. Drought Monitor Map** Students have colored in the drought severity for Georgia (2pts.), students have used the color legend and colored in the border states' drought severity information (2 pts.), student have found a state with moderate drought, (2pts) a state with severe drought (2pts.) and a state with exceptional drought (2 pts.), a state with agricultural drought, (2pts.) and hydrological drought (2 pts.) 14 point total U.S. Map _____

6. **Drought in Georgia – Effects** Students will research and record 2 Web sites and 2 effects of drought for questions 1-5 on Worksheet # 3 that includes crops, livestock, plants and trees, stream flows and lake levels, and wildlife. Students receive 2 pts. for each Web site and 2 pts. for each effect found. They have been asked to find at least 2 Web sites and 2 effects for each topic. 20 point total Georgia map (students can earn extra pts.) _____

7. **Comparing Georgia and New South Wales** Students will Compare these 2 states in population, (3 pts.) land size (3 pts.) and latitude and longitude (3 pts.) using their Georgia and New South Wales maps. 9 point total _____

8. **Learning about drought in Australia** Students will need to record drought information from at least 3 Web sites on their New South Wales map. (2 pts. each) 12 point total _____

9. **Written Comparison Paragraph on Drought** Students have been asked to write a paragraph comparing the drought in Georgia to the drought in New South Wales and provide 2 similarities and 2 differences. 10 point total _____

10. **Anticipation Guide** The Anticipation Guide is now given to students to fill out having the advantage of their research. Students should be able to give 3 effects of drought at 2 pts. each – 6 pt. total Anticipation Guide _____

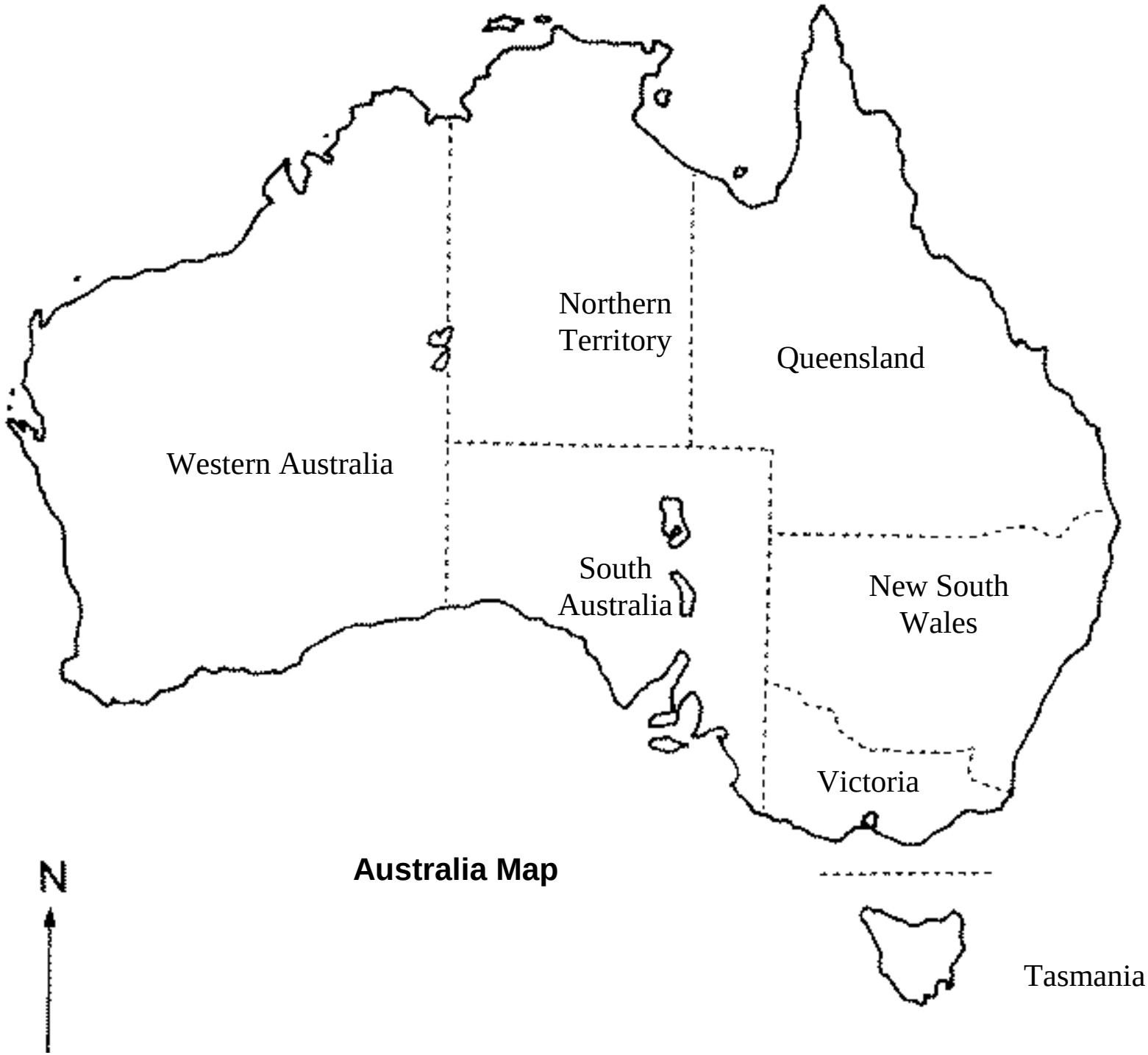
100 point total **Research Total points** _____


British Columbia
Alberta
Saskatchewan
Canada
Manitoba
Ontario
Quebec
New Brunswick
Washington
Montana
North Dakota
Minnesota
Maine
Nova Scotia
Oregon
Idaho
South Dakota
Wisconsin
Vermont
New Hampshire
New York
Massachusetts
Wyoming
Michigan
Connecticut
Rhode Island
Nevada
Nebraska
Iowa
Pennsylvania
New Jersey
Illinois
Indiana
Ohio
Delaware
Maryland
California
Utah
Colorado
Kansas
Missouri
West Virginia
Virginia
U. S. A.
Kentucky
North Carolina
Tennessee
Oklahoma
Arkansas
South Carolina
Arizona
New Mexico
Mississippi
Alabama
Georgia
Texas
Louisiana
Florida
Russia
Alaska
Canada
Hawaii
Mexico
The Bahamas

USA Map

Georgia Map

New South Wales Australia Map



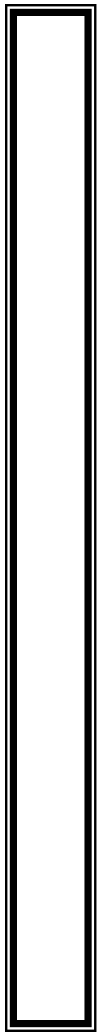
Australia Map

Anticipation Guide

Causes

Effects

Draw a picture of drought here.



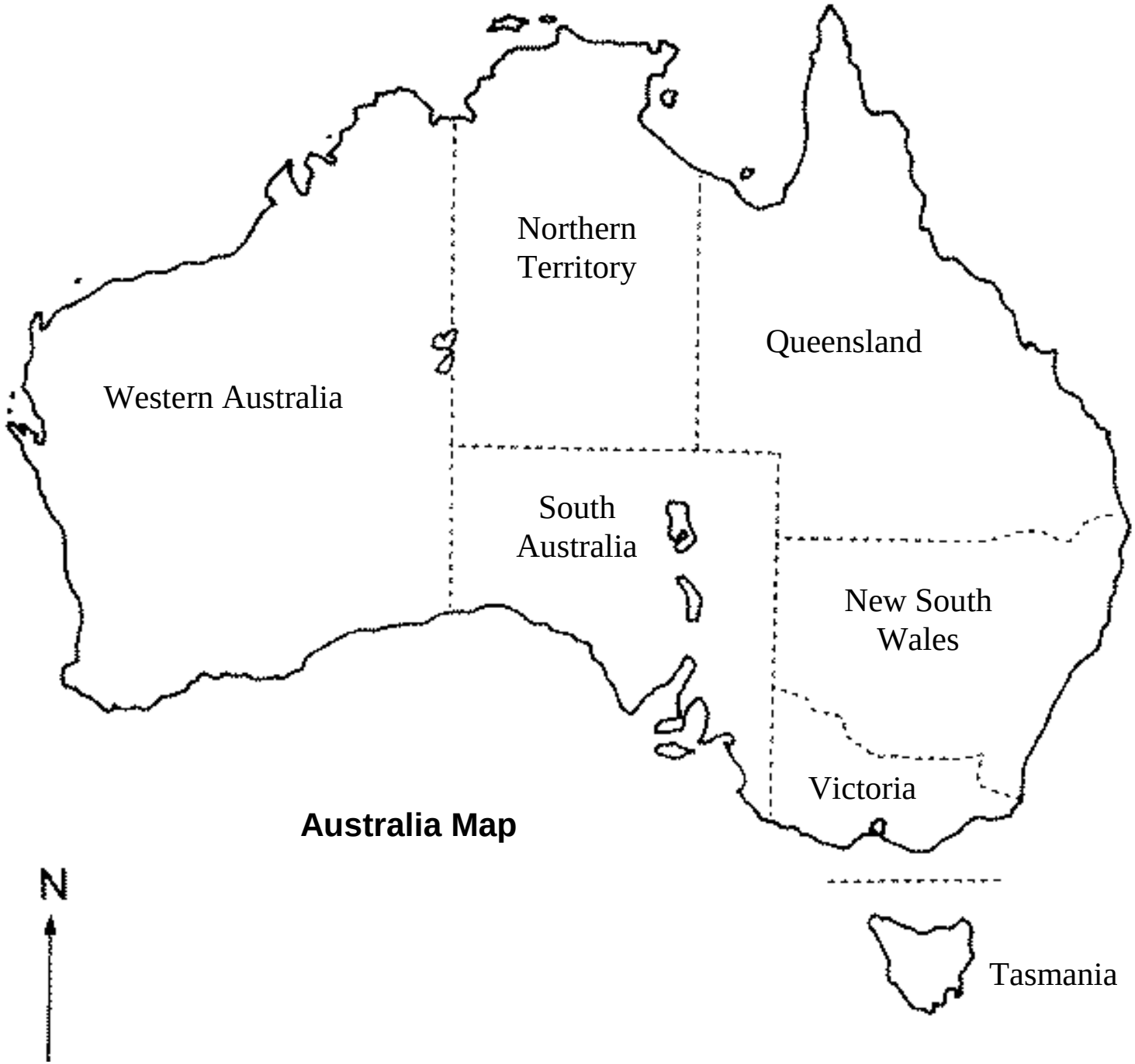
Who Shut Off My Water
Cause and Effects


British Columbia
Alberta
Saskatchewan
Canada
Ontario
Quebec
Manitoba
New Brunswick
Washington
Montana
North Dakota
Minnesota
Maine
Nova Scotia
Oregon
Idaho
South Dakota
Wisconsin
Vermont
New Hampshire
New York
Massachusetts
Wyoming
Michigan
Connecticut
Rhode Island
Nevada
Nebraska
Iowa
Pennsylvania
New Jersey
Illinois
Indiana
Ohio
Delaware
Maryland
California
Utah
Colorado
Kansas
Missouri
West Virginia
Virginia
U. S. A.
Kentucky
North Carolina
Tennessee
Oklahoma
Arkansas
South Carolina
Arizona
New Mexico
Mississippi
Alabama
Georgia
Texas
Louisiana
Florida
Russia
Alaska
Canada
Hawaii
Mexico
The Bahamas

USA Map

Georgia Map

New South Wales Australia Map



Australia Map

Anticipation Guide

Causes

Draw a picture of drought here.

Effects

Teacher Checklist for Research Assessment
Lesson 2
Cause and Effects

Student_____

Total Points

1. **Anticipation Guide** No attempt to fill in (2 pts.) or attempt to draw a picture of drought and have a cause and effect. (5 pts.) 5 point total _____

2. **Water cycle diagram** 8 or more water cycle words in their correct places (8 pts.) 5-7 water cycle words (6 pts.) or less than 5 (4 pts.) 8 point total Worksheet #1 _____

3. **Cause of drought** well written (2 pts.) _____
(See teacher background) Worksheet #1 2 point total

4. **Annual Rainfall Map** Students have placed all 7 cities in the correct geographic location on the Georgia map (7pts.) students have researched and recorded annual rainfall for the 7 cities (7 pts.) 14 point total Georgia map _____

5. **Drought Severity – U.S. Drought Monitor Map** Students have colored in the drought severity for Georgia (2pts.), students have used the color legend and colored in the border states' drought severity information (2 pts.), student have found a state with moderate drought, (2pts) a state with severe drought (2pts.) and a state with exceptional drought (2 pts.), a state with agricultural drought, (2pts.) and hydrological drought (2 pts.) 14 point total U.S. Map _____

6. **Drought in Georgia – Effects** Students will research and record 2 Web sites and 2 effects of drought for questions 1-5 on Worksheet # 3 that includes crops, livestock, plants and trees, stream flows and lake levels, and wildlife. Students receive 2 pts. for each Web site and 2 pts. for each effect found. They have been asked to find at least 2 Web sites and 2 effects for each topic. 20 point total Georgia map (students can earn extra pts.) _____

7. **Comparing Georgia and New South Wales** Students will Compare these 2 states in population, (3 pts.) land size (3 pts.) and latitude and longitude (3 pts.) using their Georgia and New South Wales maps. 9 point total _____

8. **Learning about drought in Australia** Students will need to record drought information from at least 3 Web sites on their New South Wales map. (2 pts. each) 12 point total _____

9. **Written Comparison Paragraph on Drought** Students have been asked to write a paragraph comparing the drought in Georgia to the drought in New South Wales and provide 2 similarities and 2 differences. 10 point total _____

10. **Anticipation Guide** The Anticipation Guide is now given to students to fill out having the advantage of their research. Students should be able to give 3 effects of drought at 2 pts. each – 6 pt. total Anticipation Guide _____

100 point total **Research Total points** _____

Drought in Georgia
Standards-Based Activities and Background Information for Earth Science Teachers
Lesson 3
Investigating Drought
Teacher Background Information

A variety of scientists study drought conditions, including climatologists, meteorologists, researchers at the United States Geological Survey and National Weather Service, members of the Georgia Environmental Protection Division staff as well as water utilities managers and cooperative extension agents. These professionals have training and expertise in monitoring and analyzing critical factors and indicators associated with drought.

Scientists study a great deal of data to analyze drought conditions and to make decisions. A sophisticated system for measuring drought was developed by meteorologist Wayne Palmer for the National Weather Service in 1965. Now known as the Palmer Drought Severity Index (PDSI), it uses temperature and rainfall to determine dryness and has become a semi-official drought index. The Georgia Automated Environmental Monitoring Network (AEMN) was established in 1991 by the College of Agriculture and Environmental Sciences of the University of Georgia to assist the monitoring of conditions such as drought. In addition, officials at the Environmental Protection Division of the Georgia Department of Natural Resources look at many indicators of moisture in the state, including groundwater levels, streamflows, reservoir levels, rainfall for the last 90 days, expected precipitation in the next 90 days, and water use patterns across the state. Scientists also use simple tools such as rain gauges and soil moisture probes to analyze various drought conditions.

In late June 2006, the Director of the Georgia Environmental Protection Division declared a Level One drought across the state and across all nine climate divisions in Georgia. There are four levels of drought in Georgia with Level One being the least severe. Each level requires a drought response. The State Drought Response Committee, which includes representatives from state, federal and local agencies along with university and non-governmental agencies, advises the Director of the Environmental Protection Division to make such decisions. A decision is made after monitoring stream flows, lake levels, precipitation, groundwater levels, soil moisture and other climatic indicators. http://www.gaepd.org/Files_PDF/news/Georgia_EPD_News_Release_Drought_Declaration.pdf

(continued)

Monday, Wednesday, Saturday: Even addresses; Tuesday, Thursday, Sunday: Odd addresses

Declared Drought Responses: Level One

Water on scheduled days – 12 midnight to 10 a.m. – and – 4 p.m. to 12 midnight.

Declared Drought Response: Level Two

Water on scheduled days – 12 midnight to 10 a.m.

Declared Drought Response: Level Three

Water on scheduled weekend day – 12 midnight to 10 a.m.

Declared Drought Response: Level Four

Complete outdoor water use ban

Researchers investigate drought and other natural phenomena through the process of scientific inquiry. This process is guided by observations, targeted questions and hypotheses, experimental procedures and investigational design, collection of valid and reliable data through appropriate tools, analysis of data to determine reasonable explanations, and communication of results for necessary action.

Vocabulary:

Analyze—To examine methodically by separating into parts and studying the interrelationships of those parts

Climatologist—A scientist who studies climate as the prevailing weather conditions of a place, including climate data, the analysis of causes of the differences in climate, and the application of climate data to the solution of specific problems

Meteorologist—A scientist who studies the atmosphere and atmospheric conditions

Monitor—To keep track of systematically with a view to collecting information; to test or sample on a regular basis

Scientific Inquiry/Method—Investigation done through a step-by-step, logical method; a body of techniques for investigating phenomena and acquiring new knowledge or correcting or integrating previous knowledge; generally includes the steps of observing, hypothesizing, testing, concluding, and reporting and discussing results

Investigating Drought

Key Words: analyze, climatologist, meteorologist, monitor, scientific inquiry/method

Desired Outcomes

Goals:

S6E3. Students will recognize the significant role of water in earth processes.

b. Relate various atmospheric conditions to stages of the water cycle.

S6CS4. Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities.

c. Read analog and digital meters on instruments used to make direct measurements of length, volume, weight, elapsed time, rates, and temperature, and choose appropriate units for reporting various quantities.

S6CS6. Students will communicate scientific ideas and activities clearly.

a. Write clear, step-by-step instructions for conducting scientific investigations, operating a piece of equipment, or following a procedure.
b. Understand and describe how writing for scientific purposes is different than writing for literary purposes.
c. Organize scientific information using appropriate tables, charts, and graphs, and identify relationships they reveal.

S6CS9. Students will investigate the features of the process of scientific inquiry.

a. Scientific investigations are conducted for different reasons. They usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations.
b. Scientists often collaborate to design research. To prevent bias, scientists conduct independent studies of the same questions.
c. Accurate record keeping, data sharing, and replication of results are essential for maintaining an investigator's credibility with other scientists and society.
d. Scientists use technology and mathematics to enhance the process of scientific inquiry.

Understandings:

Students will understand that…

- scientists and other professionals engage in drought research utilizing appropriate skills and training
- scientists use specialized tools and techniques to collect and analyze data about drought conditions
- scientists look at a variety of indicators and references to determine drought conditions
- scientific inquiry is a process for questioning, investigating, gathering

Essential Questions:

- What interests, education, and training do scientists need to study drought?
- What tools do scientists use to study drought?
- How do scientists determine if we are in a drought situation?
- What skills are involved in scientific inquiry concerning drought?

data, explaining, and communicating.	
Students will know… • that scientists utilize training, knowledge, and inquiry methods to investigate drought • that scientists collect and analyze drought data by means of specialized tools and resources • that scientists constantly monitor and evaluate drought conditions in Georgia • that scientific inquiry is an organized series of logical, methodical steps.	**Students will be able to…** • describe the job of a scientist who studies drought • list tools and resources that scientists use to study drought. • perform simple soil moisture and rainfall measures • discuss ways that scientists determine if a drought situation exists • outline and plan a method of scientific inquiry.
Lesson Hook: Students review introductory letters from professional scientists who are directly involved in studying drought and soil conditions in Georgia. (See attached scientists' letters.)	
Assessment	
Performance Tasks: Using a scientifically sound inquiry method, students work in groups to develop a written plan for collecting, analyzing, and communicating information to determine if Georgia is in a drought situation. Groups present their plans to the entire class, as teachers note the inclusion of the following scientific inquiry/scientific method components in each plan: • Statement of the problem • Research question or hypothesis • A research plan or design • Measurements or tests to collect data under controlled conditions • Analysis and interpretation of the data • Communication of conclusions based on the data The National Science Education Standards (National Academy of Sciences,1996) provide an explanatory note: Scientific method abilities "do not imply a rigid approach to scientific inquiry. On the contrary, they imply codevelopment of the skills of students in acquiring science knowledge, in using high-level reasoning, in applying their existing understanding of scientific ideas, and in communicating scientific information" (pp. 144-145). Students use rain gauges and/or soil moisture probes or other appropriate instrumentation to make observations and collect local data associated with drought conditions. Students demonstrate appropriate application, accuracy of measurement, and skillful and careful use of at least one such instrument.	

Other Evidence: Students summarize how the Environmental Protection Division actually determines if Georgia is in a drought and subsequent actions. (Review the attachment on how EPD monitors drought conditions.)

Plan of Action

Tasks:

Lesson 1: Thinking Scientifically About Drought: One-two class periods

1. Following students' reading of the scientists' letters designated in the Lesson Hook, teachers review vocabulary (found at the end of the Teacher Background Information section) and the scientific method (outlined in the Assessment section above).
2. Teachers then ask students to think like scientists to develop a process for collecting and analyzing information to answer the research question: *How do we determine if Georgia is in a drought situation?*
3. Teachers pose the following additional questions*: What evidence or observations do we need to determine if there is a drought? How could we collect data? What could we measure? How could we best measure it? What tools would we need? How do we analyze, interpret and communicate our findings and results? Where could we find information to help answer questions about drought?*
4. Teachers facilitate the process of investigating drought with appropriate inquiry worksheets (http://trackstar.4teachers.org Search scientific method for model worksheets) to guide the planning effort and allow time for students to work in groups to create a plan that should include use of rain gauges/soil probes (See Lesson 3 below) and all of the following steps of scientific inquiry: statement of the problem, research question or hypothesis, a research plan/design, collection of data, analysis and interpretation of data, communication of conclusions. Guidelines for science fair projects are also helpful for outlining the scientific method, as provided in the Web site below: http://school.discovery.com/sciencefaircentral/scifairstudio/handbook/scientificmethod.html

Lesson 2: Determining A Drought Situation: One class period

1. Teachers explain how the Director of the Environmental Protection Division determines if the state is in a drought (Review the attachment on how EPD monitors drought conditions.)
2. Students present their plans to determine Georgia's drought situation and compare their plans from Lesson 1 to the state's overall plan.

Lesson 3: Using Scientific Tools To Investigate Drought: Time varies depending on

student investigations

Students use rain gauges and soil probes as part of executing their drought investigation plan from Lesson 1. (Teachers may choose to use these tools for demonstration purposes rather than active student participation if necessary.)

Instruments are available at the Web sites listed in Additional Resources. Instructions for making a rain gauge and for a "tool-less" means of soil moisture measurement are included as attachments.

Additional Resources:

General Drought Information Websites:
http://earthobservatory.nasa.gov/Library/DroughtFacts/drought_facts_2.html
http://www.georgiaweather.net
http://www.griffin.peachnet.edu/bae/
http://www.caes.uga.edu/topics/disasters/drought/restrictions/faq.html
http://www.conservewatergeorgia.net/Documents/georgia_drought.html
http://www.ga.water.usgs.gov/drought.html

Scientific Inquiry Worksheet: http://trackstar.4teachers.org (search: scientific method)
Also refer to various science fair project guidelines such as
http://school.discovery.com/sciencefaircentral/scifairstudio/handbook/scientificmethod.html

Environmental Protection Division Steps to Determine Drought: http://www.gaepd.org/Files_PDF/gaenviron/drought/drought_mgmtplan_2003.pdf

Rain Gauge and Soil Moisture Probe Information:
http://www.globe.gov (a comprehensive program on data collection protocols for soil, etc.)
http://globeassessment.sri.com/soils/moistureProtocol.html
http://www.hwr.arizona.edu/globe/globe3/SMSite.html
http://www.miamisci.org/hurricane/rainmeasure.html
http://www.fi.edu/weather/todo/r-gauge.html
http://school.discovery.com/lessonplans/activities/weatherstation/
http://www.ars.usda.gov/is/AR/archive/mar04/planet0304.htm
http://www.ext.colostate.edu/pubs/crops/04700.html

Options for Purchasing Rain Gauges or Soil Probes:
http://www.KidsGardeningStore.com
http://www.acornnaturalists.com
http://www2.carolina.com
http://www.forestry-suppliers.com
http://www.ambientweather.com

Dear Students,

My name is Jim Lathem and I am a soil scientist with the USDA Natural Resources Conservation Service (NRCS). Let me tell you a little about my career background and current job.

My area of professional expertise is a field of science called "Pedology". Pedology is the study of soil in its natural environment. Pedology deals with soil formation (the process by which soil is created), soil morphology (the structure and make-up of natural soils), and soil classification (a system of taxonomy used to categorize soils based on morphology).

I graduated college in 1980 with a bachelor's degree in Agronomy. My major field of study was soil science. In January of 1981, I went to work with NRCS as a field soil scientist.

I have spent most of my career studying and mapping soils throughout Georgia for the National Cooperative Soil Survey Program. Also, I studied and mapped soils near the Canadian border in North Dakota. The soil survey maps that I made are utilized to assist farmers, foresters, developers and others in understanding soils and helping land users to make wise land use decisions. You can look for soils maps in your area by visiting the Web Soil Survey online at http://websoilsurvey.nrcs.usda.gov/app/ or by contacting your local USDA NRCS office.

This is a photo of taken in the mid-1980s with a team consisting of me, 2 plant scientists and a biologist working on a comprehensive natural resource assessment in a river swamp in middle Georgia. *(I'm the second one from the right in the photo. I'm holding a soils*

auger which is a coring device capable of boring holes 5 feet or more into the ground)

The last few years, I have been employed as a resource soil scientist. The resource soil scientist position is one that involves a variety of work such as soils education assistance, maintaining soil information in computer databases, providing training, and technical support for USDA programs. This job includes many different assignments and involves making recommendations about many resource areas.

In the photo on the left, I am demonstrating to college students how to observe seasonal water table levels using soil properties such as soil color. In the photo on the right, I am performing a wetland delineation. The instrument in my backpack is a global positioning system (GPS) receiver. Using this device, I can log my field data for computer download into a mapping database. In other words, a GPS can record my position and help me to make an accurate, computerized map later at my office. Being a soil scientist can be a fun, outdoor job, but you sure can get dirty sometimes!

One of the features that pedologists study in the field is the depth to the seasonal high water table (SHWT). SHWT levels can be estimated during the drier times of the year by observing soil features such as patterns of soil colors, presence of thick organic layers, or the presence of layers of certain minerals in the soil such as manganese. During the wet seasons, SHWT can be directly observed through boreholes or can be directly recorded using special devices such as piezometers. Piezometers are tools that read water pressures and ground water elevations within a borehole. Data loggers are used along with piezometers to record and store the data until it can be downloaded for processing.

Steve Lawrence and Ken Monroe, USDA NRCS soil scientists download data from a piezometer – data logger into a PDA (personal digital assistant). This data will be transferred to a computer database later.

The information that soil scientists collect and publish is vital to helping people understand soils and make wise use of this important resource. Studying seasonal high water tables is an important part of the work that a soil scientist does. For more information on soils and/or the Natural Resources Conservation Service, visit our Web site at http://soils.usda.gov/ . For more information on the job of NRCS soil scientists, click on “Teachers and Students” – “Soil facts” – “Careers”.

Hello, students!

My name is Carmen Westerfield. I grew up on a small farm in southeast Georgia near Waycross. This is the same farm my dad grew up on. I spent a lot of time with Dad in the garden, doing farm chores and fishing in the Satilla River. I have always been fascinated with looking at plants and different animals and the different colors of soils and rocks.

I have always liked the outdoors and nature, too. While I was in high school, I attended the Natural Resources Conservation Workshop where I had the opportunity to meet different professionals who worked in natural resources and forestry. This is where I learned about agronomy as a major. I attended Waycross Junior College as a science major and then transferred to the University of Georgia where I studied agronomy – crop and soil science.

One of my main reasons for selecting agronomy as my major was it offered flexibility when I graduated from college in looking for a job. During college, I interned as a soil conservationist. During this time, I learned about the work and how enjoyable it was to be able to work outdoors. I get a great deal of satisfaction in seeing practices I have designed installed on farms in my area.

Science and math are the basis of everything I do. As a district conservationist with the United States Department of Agriculture (see the attachment box about my job), I take knowledge developed in laboratories, universities, and prior field activities and apply them to solve problems on farms such as erosion, low productivity, and water quality concerns.

Studying about drought in Georgia is very important in solving problems today and preventing new ones tomorrow. We should all continue to learn more about the impacts of drought and what we can do to help conserve water. If you have any questions for me about my job or about soil science, please contact me at the email below.

Carmen Westerfield
Carmen.Westerfield@ga.usda.gov

The Job of a District Conservationist…

I am a District Conservationist with the United States Department of Agriculture, Natural Resources Conservation Service. I am a graduate from the University of Georgia with a Bachelors of Science in Agriculture, majoring in Agronomy – soil science. The Natural Resources Conservation Service (NRCS) works with people to conserve natural resources on private lands. We help land users and communities approach conservation planning and implementation with an understanding of how natural resources, such as soil and water and plants, relate to each other and to all of us – and how our activities affect those resources.

NRCS is structured across the nation as local field offices. As District Conservationist, I oversee the Barnesville field office which encompasses Lamar, Monroe, Pike and Upson counties covering 826,300 acres including the Lamar County Soil & Water Conservation District and the Towaliga Soil & Water Conservation District. These counties are located in the Piedmont Major Land Resource Area, and the field office is located in two major river basins with half the area flowing to the Flint River and the other half flowing to the Ocmulgee River.

Conservation Planning has always been the foundation of our work. We provide technical assistance to landowners interested in managing their land to protect their natural resources. Based on an inventory of the producer's resources as well as needs and desires, we give them information and develop management alternatives. We evaluate a number of resources such as soil erosion rates, type of wildlife habitat, quality of forage and grasses, cropping systems and water sources. From this information we help them develop a conservation management plan, with a time line for implementation, which addresses as many aspects of their operation as possible. We use a variety of tools such as aerial photography using computer generated maps, topographical maps, and soils maps. As the producer's needs and resources change over time; the written plan is revised to meet the owner's new objectives.
The assistance ranges from pasture renovation to watering facilities, to setting up rotational grazing systems. Because most water sources are dependent on surface water, technical assistance on pond construction, maintenance and renovation is still requested. There is also a growing interest in water quality concerning stream and pond protection requesting such practices as stream crossings, fencing, livestock exclusion, watering ramps, gravity flow troughs, and other forms of alternative livestock water. We design the practices specific to the farm to protect and conserve the resource, water and soil.

NRCS assists landowners within conservation districts to develop and apply resource conservation systems to solve erosion, water quality, water conservation and other resource condition problems on cropland, pastureland, woodland, rangeland, mined land, and other disturbed areas. It also helps landowners and operators conserve, manage, improve, and increase habitat for fish and wildlife.

NRCS provides technical assistance to units of government on urban erosion, flooding, and on the protection of prime, important, and unique lands. We provide technical guidance on conservation, soils interpretations and other land and water resource information to both public and private concerns, rural and urban, and assists them in making sound land use plans and decisions.

As a conservationist I am required to maintain a working knowledge of a wide range of professional soil and water conservation principles, methods, and techniques sufficient to skillfully assess, analyze, and evaluate complex environmental conditions including severely eroded land, land vulnerable to flooding, and areas used for agricultural, residential, and commercial purposes. Short- and long-term conservation plans are developed using this knowledge, which is described in detail below:

--knowledge of agronomy, animal science, water quality (as related to consumption), horticulture, plant materials, economics, recreation, range conservation, hydrology, biology, forestry, and practical engineering techniques sufficient to advise and recommend on natural resource development and treatment alternatives for conservation plans involving a variety of land uses, soils, and conservation practices

--knowledge and skill in communication methods and procedures sufficient to discuss, explain, and advocate soil and water conservation measures, plans and objectives at meetings involving diverse groups of rural and community landowners, conservation leaders, agribusiness representatives, engineering firms, urban planners and developers and representatives from state and federal agencies; skill in clearly presenting supporting facts and data justifying the rationale for specific measures and alternatives.

Utilizing this knowledge, conservation practices are also designed to conserve water. Practices such as good pasture management, rotational grazing, and conservation tillage improve soil health by slowing runoff, improving infiltration, and increasing soil moisture while reducing downstream sediment.

All of these responsibilities make the job of a district conservationist very interesting!

--Carmen Westerfield

Carmen Westerfield and Leesa Woodall looking at planted trees in a wetland area

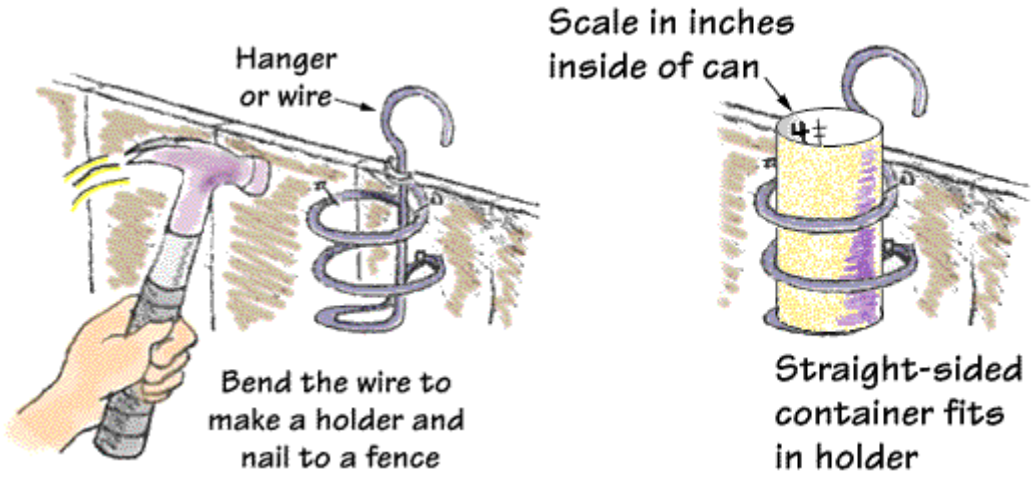
Carmen and local farmer Jack Walters discussing tree planting

Carmen Westerfield takes clip samples to evaluate forages in a pasture

How does the EPD monitor drought conditions?

Officials at EPD look at many indicators of moisture in the state, including groundwater levels, streamflows, reservoir levels, rainfall in the last 3, 6, and 12 months and expected precipitation in the next 90 days, and water use patterns across the state (all that comes from the state climatologist, United States Geological Survey, United States Army Corps of Engineers, National Weather Service, etc.) to monitor drought conditions. Depending on the extent of dryness, these indicators are said to be on different numerical levels reflecting the severity of a drought. Based on the severity of drought reflected by these indicators, EPD makes a decision to (or not to) put water-use restrictions in place. It's not done lightly — there's a lot of scientific data that goes into the decision and they realize the effect it has on day-to-day life for the people of Georgia. However, they do have your best interests in mind and are working to ensure a continued supply of drinking water.

Make Your Own Rain Gauge



You'll need these materials:

a glass beaker (or any straight-sided glass that can be marked with a measuring scale)
a coat hanger or wire (bent to make a holding rack -- see picture)
hammer and nails (to secure the rack)

Basically, any measuring glass left outside can serve as a rain gauge. However, since most rain showers are usually quite windy, you'll want to fasten your rain gauge somewhere so that it doesn't blow over. Locate a good place for your gauge. There should be nothing overhead, like trees, electric wires, or the edge of a roof. These obstructions can direct rainwater into or away from your gauge, creating a false reading. The edge of a fence, away from the building, is often a good place for your gauge.

Once you have found the spot, attach the holding rack (refer to picture). Then, slip your measuring glass into position. Wait for rain, then record your measurement, and empty the glass.

Table 1: Soil moisture interpretation chart.			
Soil moisture deficiency	**Moderately coarse texture**	**Medium texture**	**Fine and very fine texture**
0% (field capacity)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand.		
0-25%	Forms weak ball, breaks easily when bounced in hand.*	Forms ball, very pliable, slicks readily.*	Easily ribbons out between thumb and forefinger.*
25-50%	Will form ball, but falls apart when bounced in hand.*	Forms ball, slicks under pressure.*	Forms ball, will ribbon out between thumb and forefinger.*
50-75%	Appears dry, will not form ball with pressure.*	Crumbly, holds together from pressure.*	Somewhat pliable, will ball under pressure.*
75-100%	Dry, loose, flows through fingers.	Powdery, crumbles easily.	Hard, difficult to break into powder.
*Squeeze a handful of soil firmly to make ball test.			

The feel and appearance of soil indicate soil moisture status. Use an auger or spade to sample soils to determine moisture content. Take soil samples throughout the depth of active plant root zones. Make an estimate of soil moisture status by firmly squeezing a handful of soil and comparing it with Table 1 above.

Table 1, excerpted from http://www.ext.colostate.edu/pubs/crops/04700.html*, may be used to provide a method of soil moisture evaluation if tools such as soil probes are unavailable to students.*

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One of my main reasons for selecting agronomy as my major was it offered flexibility when I graduated from college in looking for a job. During college, I interned as a soil conservationist. During this time, I learned about the work and how enjoyable it was to be able to work outdoors. I get a great deal of satisfaction in seeing practices I have designed installed on farms in my area.

Science and math are the basis of everything I do. As a district conservationist with the United States Department of Agriculture (see the attachment box about my job), I take knowledge developed in laboratories, universities, and prior field activities and apply them to solve problems on farms such as erosion, low productivity, and water quality concerns.

Studying about drought in Georgia is very important in solving problems today and preventing new ones tomorrow. We should all continue to learn more about the impacts of drought and what we can do to help conserve water. If you have any questions for me about my job or about soil science, please contact me at the email below.

Carmen Westerfield
Carmen.Westerfield@ga.usda.gov

The Job of a District Conservationist…

I am a District Conservationist with the United States Department of Agriculture, Natural Resources Conservation Service. I am a graduate from the University of Georgia with a Bachelors of Science in Agriculture, majoring in Agronomy – soil science. The Natural Resources Conservation Service (NRCS) works with people to conserve natural resources on private lands. We help land users and communities approach conservation planning and implementation with an understanding of how natural resources, such as soil and water and plants, relate to each other and to all of us – and how our activities affect those resources.

NRCS is structured across the nation as local field offices. As District Conservationist, I oversee the Barnesville field office which encompasses Lamar, Monroe, Pike and Upson counties covering 826,300 acres including the Lamar County Soil & Water Conservation District and the Towaliga Soil & Water Conservation District. These counties are located in the Piedmont Major Land Resource Area, and the field office is located in two major river basins with half the area flowing to the Flint River and the other half flowing to the Ocmulgee River.

Conservation Planning has always been the foundation of our work. We provide technical assistance to landowners interested in managing their land to protect their natural resources. Based on an inventory of the producer's resources as well as needs and desires, we give them information and develop management alternatives. We evaluate a number of resources such as soil erosion rates, type of wildlife habitat, quality of forage and grasses, cropping systems and water sources. From this information we help them develop a conservation management plan, with a time line for implementation, which addresses as many aspects of their operation as possible. We use a variety of tools such as aerial photography using computer generated maps, topographical maps, and soils maps. As the producer's needs and resources change over time; the written plan is revised to meet the owner's new objectives.
The assistance ranges from pasture renovation to watering facilities, to setting up rotational grazing systems. Because most water sources are dependent on surface water, technical assistance on pond construction, maintenance and renovation is still requested. There is also a growing interest in water quality concerning stream and pond protection requesting such practices as stream crossings, fencing, livestock exclusion, watering ramps, gravity flow troughs, and other forms of alternative livestock water. We design the practices specific to the farm to protect and conserve the resource, water and soil.

NRCS assists landowners within conservation districts to develop and apply resource conservation systems to solve erosion, water quality, water conservation and other resource condition problems on cropland, pastureland, woodland, rangeland, mined land, and other disturbed areas. It also helps landowners and operators conserve, manage, improve, and increase habitat for fish and wildlife.

NRCS provides technical assistance to units of government on urban erosion, flooding, and on the protection of prime, important, and unique lands. We provide technical guidance on conservation, soils interpretations and other land and water resource information to both public and private concerns, rural and urban, and assists them in making sound land use plans and decisions.

As a conservationist I am required to maintain a working knowledge of a wide range of professional soil and water conservation principles, methods, and techniques sufficient to skillfully assess, analyze, and evaluate complex environmental conditions including severely eroded land, land vulnerable to flooding, and areas used for agricultural, residential, and commercial purposes. Short- and long-term conservation plans are developed using this knowledge, which is described in detail below:

--knowledge of agronomy, animal science, water quality (as related to consumption), horticulture, plant materials, economics, recreation, range conservation, hydrology, biology, forestry, and practical engineering techniques sufficient to advise and recommend on natural resource development and treatment alternatives for conservation plans involving a variety of land uses, soils, and conservation practices

--knowledge and skill in communication methods and procedures sufficient to discuss, explain, and advocate soil and water conservation measures, plans and objectives at meetings involving diverse groups of rural and community landowners, conservation leaders, agribusiness representatives, engineering firms, urban planners and developers and representatives from state and federal agencies; skill in clearly presenting supporting facts and data justifying the rationale for specific measures and alternatives.

Utilizing this knowledge, conservation practices are also designed to conserve water. Practices such as good pasture management, rotational grazing, and conservation tillage improve soil health by slowing runoff, improving infiltration, and increasing soil moisture while reducing downstream sediment.

All of these responsibilities make the job of a district conservationist very interesting!

--Carmen Westerfield

Carmen Westerfield and Leesa Woodall looking at planted trees in a wetland area

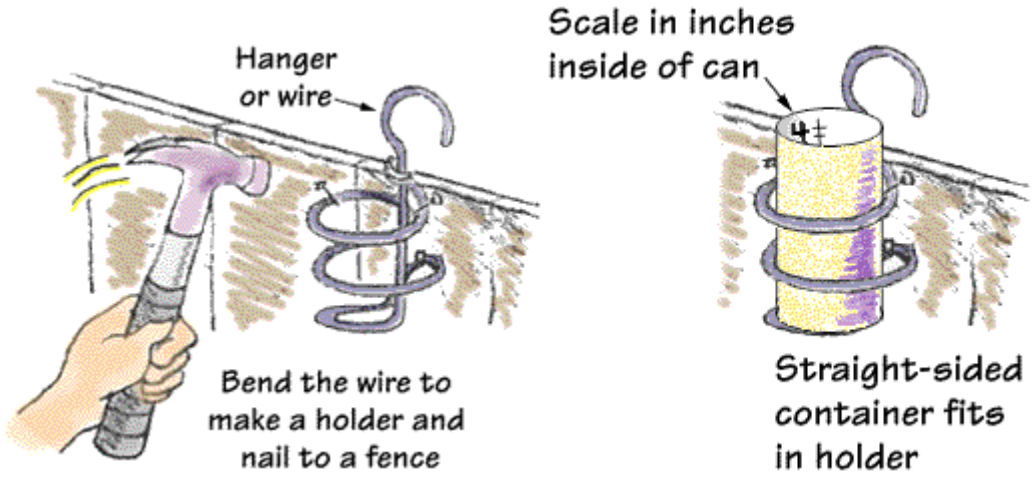
Carmen and local farmer Jack Walters discussing tree planting

Carmen Westerfield takes clip samples to evaluate forages in a pasture

How does the EPD monitor drought conditions?

Officials at EPD look at many indicators of moisture in the state, including groundwater levels, streamflows, reservoir levels, rainfall in the last 3, 6, and 12 months and expected precipitation in the next 90 days, and water use patterns across the state (all that comes from the state climatologist, United States Geological Survey, United States Army Corps of Engineers, National Weather Service, etc.) to monitor drought conditions. Depending on the extent of dryness, these indicators are said to be on different numerical levels reflecting the severity of a drought. Based on the severity of drought reflected by these indicators, EPD makes a decision to (or not to) put water-use restrictions in place. It's not done lightly — there's a lot of scientific data that goes into the decision and they realize the effect it has on day-to-day life for the people of Georgia. However, they do have your best interests in mind and are working to ensure a continued supply of drinking water.

Make Your Own Rain Gauge



You'll need these materials:

a glass beaker (or any straight-sided glass that can be marked with a measuring scale)
a coat hanger or wire (bent to make a holding rack -- see picture)
hammer and nails (to secure the rack)

Basically, any measuring glass left outside can serve as a rain gauge. However, since most rain showers are usually quite windy, you'll want to fasten your rain gauge somewhere so that it doesn't blow over. Locate a good place for your gauge. There should be nothing overhead, like trees, electric wires, or the edge of a roof. These obstructions can direct rainwater into or away from your gauge, creating a false reading. The edge of a fence, away from the building, is often a good place for your gauge.

Once you have found the spot, attach the holding rack (refer to picture). Then, slip your measuring glass into position. Wait for rain, then record your measurement, and empty the glass.

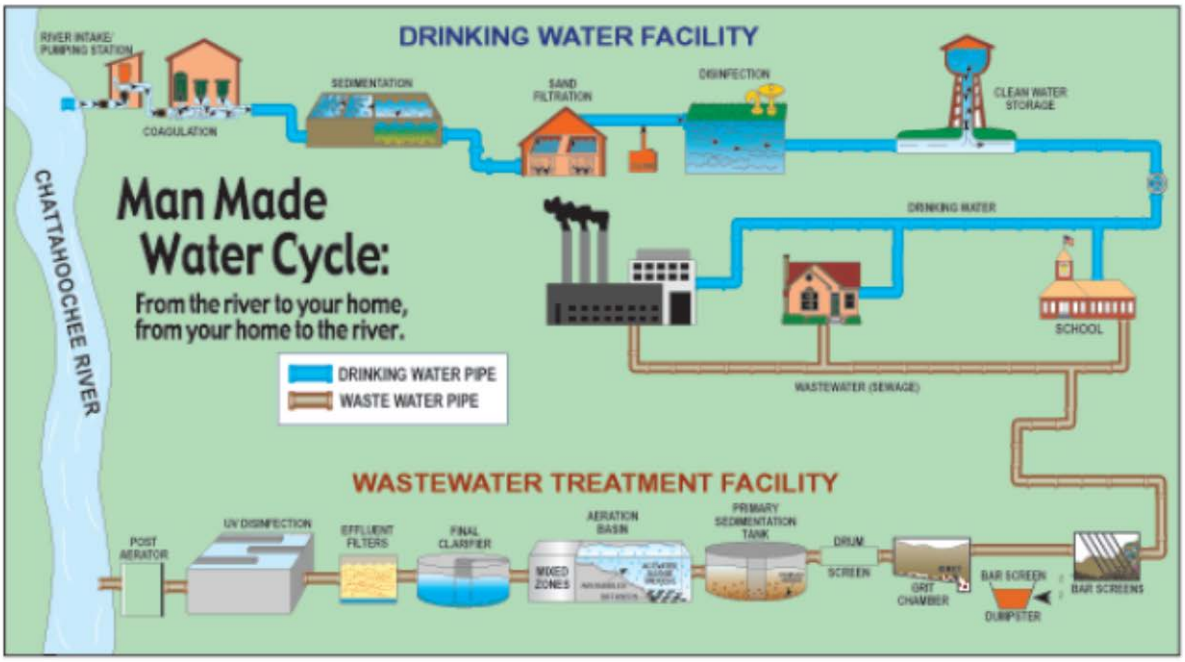
Table 1: Soil moisture interpretation chart.			
Soil moisture deficiency	**Moderately coarse texture**	**Medium texture**	**Fine and very fine texture**
0% (field capacity)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand.		
0-25%	Forms weak ball, breaks easily when bounced in hand.*	Forms ball, very pliable, slicks readily.*	Easily ribbons out between thumb and forefinger.*
25-50%	Will form ball, but falls apart when bounced in hand.*	Forms ball, slicks under pressure.*	Forms ball, will ribbon out between thumb and forefinger.*
50-75%	Appears dry, will not form ball with pressure.*	Crumbly, holds together from pressure.*	Somewhat pliable, will ball under pressure.*
75-100%	Dry, loose, flows through fingers.	Powdery, crumbles easily.	Hard, difficult to break into powder.
*Squeeze a handful of soil firmly to make ball test.			

The feel and appearance of soil indicate soil moisture status. Use an auger or spade to sample soils to determine moisture content. Take soil samples throughout the depth of active plant root zones. Make an estimate of soil moisture status by firmly squeezing a handful of soil and comparing it with Table 1 above.

Table 1, excerpted from http://www.ext.colostate.edu/pubs/crops/04700.html*, may be used to provide a method of soil moisture evaluation if tools such as soil probes are unavailable to students.*

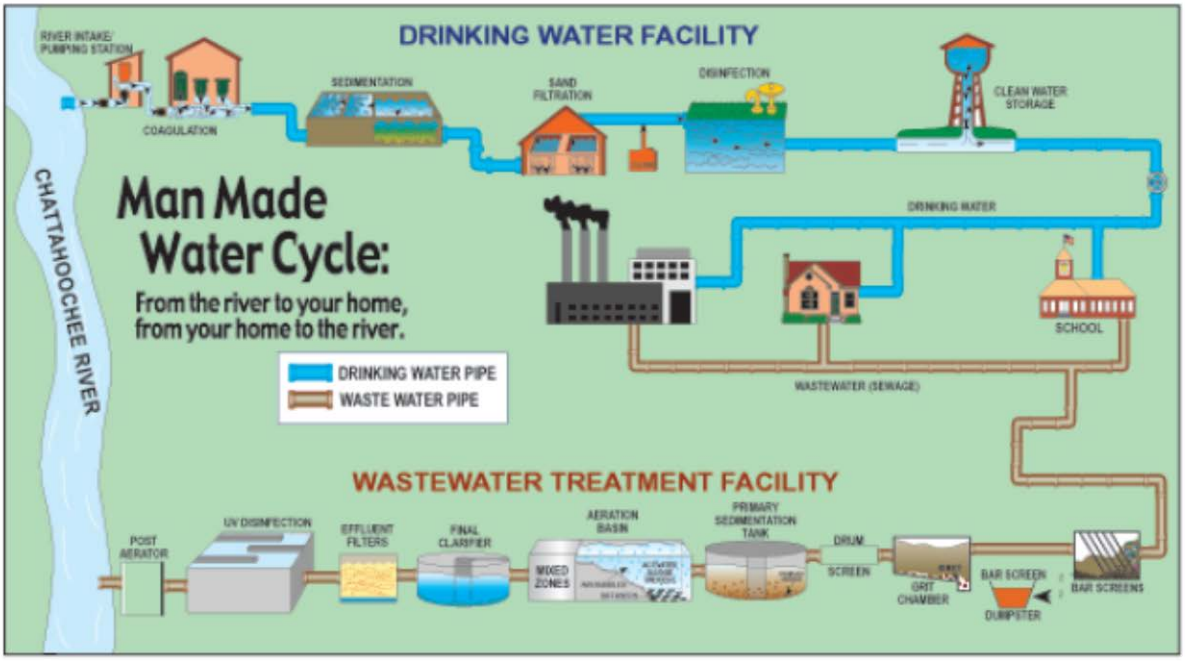
CITY OF ATLANTA • DEPARTMENT OF WATERSHED MANAGEMENT

Robert J. Hunter, Commissioner



CITY OF ATLANTA • DEPARTMENT OF WATERSHED MANAGEMENT

Robert J. Hunter, Commissioner



Balancing the River Model
Student Instruction Sheet 1

2-liter bottle = river
Sand = water

IN BALANCE

1. Carefully using the thumbtack, poke 20 evenly spaced holes in the 2-liter bottle along the outside about 1/2 inch up from the bottom. The 2-liter bottle represents the river, and the sand that will pour through the holes represents the water being piped from the river during the non-summer months. Set the 2-liter bottle aside for later.

2. This is practice - Open the bag of play sand and fill the drink pitcher ¾ of the way with it.

3. This is practice - Pour the sand from the drink pitcher into the measuring cup or graduated cylinder for one minute. Use the stopwatch to count one minute. Record the mls or cups/minute on the Student Observations Sheet.

4. This is practice - Adjust the flow of sand so it is coming out of the drink pitcher at a rate of 400 ml per minute or about 1.5 cups per minute. This represents the water entering the river during a period of normal rainfall.

5. Take the 2-liter bottle and put the funnel on top of it.

6. Put the plastic bin under the 2-liter bottle.

7. This is the real thing - Refill the drink pitcher with sand.

8. This is the real thing - Pour the sand into the 2-liter bottle at a rate of 400 ml per minute or about 1.5 cups per minute.

9. This is the real thing - Carefully watch what happens with the sand in the bottle. Try to balance the amount of sand you are pouring into the bottle with the amount of sand pouring out through the holes in the bottle so your group will arrive at a steady level where there is no longer any measurable change in the level of sand in the bottle. Water budgets for a river system help water managers understand if the river system is in balance (i.e. meeting the needs of humans and plants and animals) or if the river system is out of balance (i.e. too much water is being taken out for humans at the times critical for plant and wildlife survival.)

Balancing the River Model
Student Observations Sheet 1

IN BALANCE

1. How many mls or cups of sand did you measure in one minute the first time you tried?

2. What part of the model represented the river?

3. What part of the model represented the water entering (rainfall and runoff) and leaving (water for our uses) the river?

4. Describe how the exit flow rate from the holes changed (faster or slower) as the level of sand in the bottle increased. How did this change in rate affect the establishing of a stable level?

Balancing the River Model
Student Instruction Sheet 2

2-liter bottle = river
Sand = water

OUT OF BALANCE – DROUGHT AND OUTDOOR WATERING

1. Carefully using the thumbtack, poke 12 (60% more than the original 20) evenly spaced holes in the 2-liter bottle along the outside about 1/2 inch up from the bottom. The 2-liter bottle represents the river, and the sand that will pour through the holes represents the water being piped from the river during the summer months, a 60% increase due to outdoor watering such as using sprinklers on lawns every day. Set the 2-liter bottle aside for later.

2. This is practice - Refill the drink pitcher ¾ of the way with play sand.

3. This is practice - Adjust the flow of sand so it is coming out of the drink pitcher at a rate LESS THAN 400 ml per minute or about 1.5 cups per minute. This represents the water entering the river during a period of drought. Record the mls or cups/minute rate you choose on the Student Observations Sheet.

4. Take the 2-liter bottle and put the funnel on top of it.

5. Put the plastic bin under the 2-liter bottle.

6. This is the real thing - Refill the drink pitcher with sand.

7. This is the real thing - Pour the sand into the 2-liter bottle at the rate you chose (LESS THAN 400 ml per minute or about 1.5 cups per minute).

8. Carefully watch what happens with the sand in the bottle. There will be constant change in the level of sand in the bottle, as less will be pouring in and more will be pouring out than during the times of balance. During times of drought, it is especially important to reduce the amount of water people use to help maintain the balance (i.e. meeting the needs of humans and plants and animals).

Balancing the River Model
Student Observations Sheet 2

OUT OF BALANCE – DROUGHT AND OUTDOOR WATERING

1. How many mls or cups/minute did you choose when you adjusted the flow of sand coming out of the drink pitcher at a rate LESS THAN 400 ml per minute or about 1.5 cups per minute?

2. Identify a model other than the bottle model that could be created to represent the effects of drought and outdoor watering on a river.

   Explain why this model would be more OR less useful in illustrating the DECREASE in water entering the river during times of drought, and the INCREASE in water being piped from the river during the summer months due to outdoor watering such as using sprinklers on lawns every day.

3. Compare the effects of decreasing the flow rate of the sand pouring into the bottle and increasing the number of holes in the bottom of the bottle.

How To Read Your Meter

Where To Look On The Meter

- Locate the white numbers on the right side of the meter dial (black background). Turns of numbers in the black area register that hundreds of gallons of water have passed through the meter.
- Locate the black numbers on the left side of the meter dial (white background). Turns of numbers in the white area register indicates that 1000 gallons of water have passed through the meter.
- The meter dial is read like an automobile odometer, straight from left to right.

See how easy it is to read...

Determining Your Water Usage

Use the following example to help read your meter.

- Select a day to take an initial water meter reading.
- Write down the numbers you see on the meter odometer. Example: 0076400
- After a period of time has passed (a day or week, for example), read your meter again at approximately the same time of day. Example: 0083300
- Subtract your first reading from the second. This is your water usage for the period. Example: 0083300 - 0076400 = 6900
- The 6900 figure indicates that 6900 gallons of water have been used during the time period between the two readings. The average residential customer uses about 7,000 gallons per month.

Flow Indicator
Used when measuring very low flow through the meter. The flow indicator measures in U.S. Gallons.

Meter Dial

Leak Detector (triangle)
If no water is being used inside or outside, this indicator should not be moving. If it is rotating, you may have a leak.

Place Holder
Indicated by [0].

Meter Register
Every turn of a number in the first black register measures 10 gallons; the second, 100 gallons.

Every turn of a number in the white register measures 1000 gallons.

Meter Number

Reading Water Meters and Water Bills at Home
Student Worksheet – Page 1

METER READING 1

1. Locate the water meter at your home. It is usually located near the street on the front of your property under a metal lid. If you live in an apartment or condominium, you may need assistance from a property manager in locating the meter.

2. Open the lid and examine the face of the meter.

3. Locate the _____ numbers on the _____ side of the meter dial (black background). Turns of numbers in the black area register that _____ of gallons of water have passed through the meter.

4. Locate the _____ numbers on the _____ side of the meter dial (white background). Turns of numbers in the white area register indicates that _____ gallons of water have passed through the meter.

5. The meter dial is read like an automobile odometer, straight from _____ to _____.

6. Select a day to take an initial water meter reading.
   What is today's date? What time is it?
   Date:_____ Time: _____

7. Write down the numbers you see on the meter odometer. Example: 0076400
   _____

METER READING 2

8. After a week has passed, read your meter again at approximately the same time of day.
   What is today's date? What time is it?
   Date:_____ Time: _____

9. Subtract your first reading from the second. This is your water usage for the period. Example: 0078150/Meter Reading 2 – 0076400/Meter Reading 1 = 1750 gallons per week.
   Record that number here. _____gallons per week

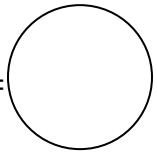
10. Ask your parents to see a copy of a current water bill. How much do you pay for water per thousand gallons per month? _____

Reading Water Meters and Water Bills at Home
Student Worksheet – Page 2

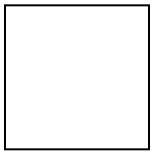
DO THE MATH!

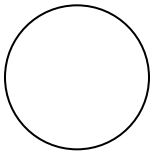
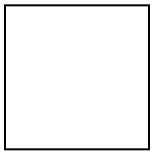
Sample Reading 2 0078150
Sample Reading 1 - 0076400
= 1750 gallons per week

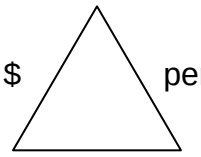
Estimate how many gallons of water this household would use in one month if the weekly usage stayed the same and how much the household would pay for water in one year.

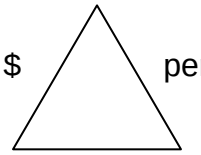
1. 1750 gallons per week x 4 weeks in a month =  gallons per month

2. $2.29 per thousand gallons per month divided by 1,000 gallons =

$  per gallon per month.

3.  gallons per month x $  per gallon per month =

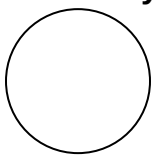
$  per month.

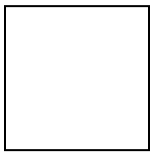
4. $  per month x 12 months per year = $_____ per year.

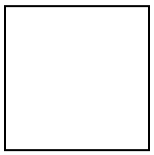
Reading Water Meters and Water Bills at Home
Student Worksheet – Page 3

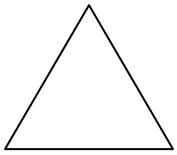
DO THE MATH!

Estimate how many gallons of water this household would use if the weekly usage increased by 60% for a period of three months, and how much the household would pay for water in one year.

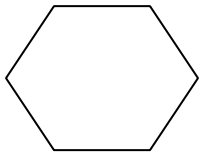
1. 1750 gallons x .60 (percent increase) =  gallons

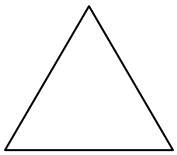
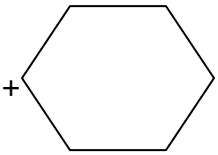
+ 1750 gallons =  gallons per week.

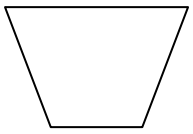
2.  gallons per week x 12 weeks (3 months) =

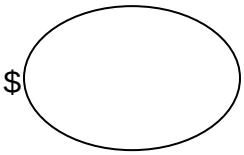
 gallons for 12 weeks.

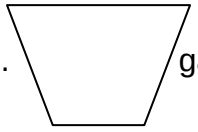
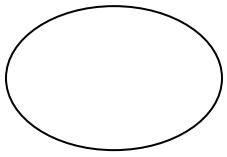
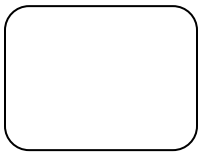
3. 1750 gallons x 40 weeks (52 weeks in a year – 12 weeks) =

 gallons for 40 weeks.

4.  gallons for 12 weeks +  gallons for 40 weeks =

 gallons per year.

5. $2.29 per thousand gallons per month divided by 1,000 gallons = $ 

6.  gallons per year x $  = $  per year.

Reading Water Meters and Water Bills at Home
Student Worksheet – Page 4

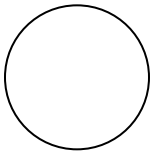
DO THE MATH! EXTRA CREDIT
Spotlight on Conservation Pricing

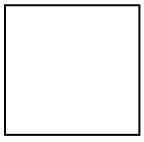
A water conservation rate structure encourages conservation and discourages over-use by charging the consumer based on the amount of water used (if you conserve, your water bill is minimal, if you use excessive amounts of water, your bill is higher).

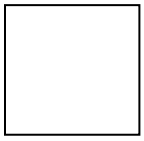
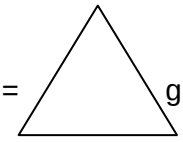
Estimate how many gallons of water this household would use if the weekly usage increased by 60% for one month, and how much that household would pay for water if the water provider used the following water conservation rate structure.
0-8,000 gallons per month.....$2.29 / per thousand gallons
8,000-15,000 gallons per month.....$2.64 / per thousand gallons

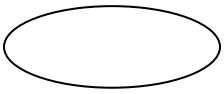
Keep in mind that the increased rates apply to usage in excess of 8,000 gallons. For example, if you use 10,000 gallons of water in a month, 8,000 will be charged the base rate of $2.29 per thousand gallons and 2,000 will be charged at the second tier rate of $2.64 per thousand gallons (http://water.cobbcountyga.gov/).

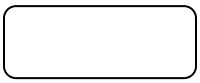
.

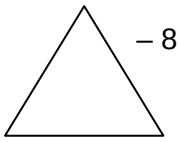
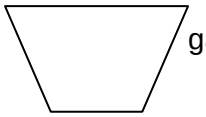
1. 1750 gallons x .60 (percent increase) =  gallons

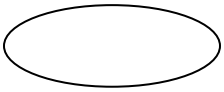
   \+ 1750 gallons =  gallons per week.

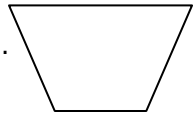
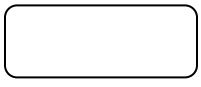
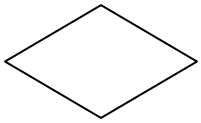
2.  gallons per week x 4 weeks (1 month) =  gallons.

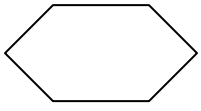
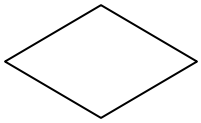
3. $2.29 per thousand gallons per month divided by 1,000 gallons = $ 

4. $2.64 per thousand gallons per month divided by 1,000 gallons = $ 

5.  – 8,000 gallons =  gallons.

6. 8,000 gallons x $  = $ 

7.  x $  = $ 

8.  +  = $ _____total paid for one month.

Understanding the Part We Play
Student Reading and Discussion Sheet – Page 1

Read the selections from the following expository compositions. For each essay: a) note the organizational pattern used and b) discuss why that pattern suited the purpose of the composition.

Compare/Contrast

Natural disasters have also thrust the Flint River into the headlines. In early July 1994, the tropical storm Alberto stalled over western Georgia. Not only did runoff from the city of Atlanta dump millions of gallons of water into the Upper Flint, but the storm dropped enough rain on southwest Georgia to submerge some cities, including Montezuma and Newton, and to cause the worst flood in Albany's recorded history. Numerous counties in the Flint basin were declared federal disaster areas; at least thirty-one people died, including fifteen in Americus and four in Albany. A second flood in Albany in March 1998 prompted plans for a levee, which are still being argued.

Paradoxically, from the summer of 1998 to the end of 2003, Georgia experienced a severe drought. The Lower Flint, because of its shallow aquifer discharge, was especially threatened. In 2000 the General Assembly passed the controversial Flint River Drought Protection Act, which aims to preserve a minimum flow in the river by paying farmers in southwest Georgia not to irrigate their land from area streams during severe drought years.
http://www.georgiaencyclopedia.org/nge/Article.jsp?path=/LandResources/Geography/MajorRiverSystems-1&id=h-3266

Description

"...Everyday I scanned the sky, looking for signs of the rain that would save my wheat from ruin. One after another, neighbors saw their crops reach a condition beyond hope of salvage."

"...Then, at last, the rain came, with a precipitation of five inches during the ensuing two days and nights, which effectively put an end to the blowing of the land for that season. With the coming of rain the whole aspect of the country changed, and I felt again the buoyancy of young manhood."

"...With my financial resources at last exhausted and my health seriously, if not permanently impaired, I am at last ready to admit defeat and leave the Dust Bowl forever. With youth and ambition ground into the very dust itself, I can only drift with the tide."
http://www.pbs.org/wgbh/amex/dustbowl/sfeature/eyewitness2.html

Understanding the Part We Play: OPTION 1
Student Reading and Discussion Sheet – Page 2

Explanation

Plants need 1 inch of water every 7 to 10 days to stay healthy. Try these 5 to help them thrive!

1. **Water only once a week.** When it hasn't rained, a deep soaking every week will provide your plants with plenty of moisture.
2. **Soak, don't sprinkle.** When you water, aim the nozzle at the base of plants so more water will reach the roots.
3. **Don't water in the heat of the day.** You will only lose water to evaporation. If you have an automatic system, set it to come on in the early morning hours between 4 a.m. and 10 a.m.
4. **Turn off sprinkler systems when it rains.** Install an inexpensive rain sensor shut-off switch.
5. **Mulch!** Using pine straw, bark chips or ground hardwood mulch on the roots of plants and trees helps the soil retain water.

www.conservewatergeorgia.net

Problem/Solution

Many people think that Georgia has plenty of water, since most of the state receives an average rainfall of over 46 inches per year. The problem, however, is that much of the water in our state is not in the right place for the populations that need it, even when we are not in a drought.

Georgia is experiencing rapid growth in many areas, with a population growth rate of over 26% statewide from 1950 to 2000. The metro Atlanta area grew from 1.39 million persons in 1960 to 4.11 million in 2000. The amount of surface water needed in the Atlanta area has grown from about 200 million gallons per day in 1960 to just under 1,000 million gallons per day in 2000. This large increase in population and other needs such as industry and electric power generation have put a strain on many existing water supplies. Cities and counties are now competing with each other for clean water sources, and even adjacent states, particularly Florida and Alabama, are trying to ensure that they can get enough water from the rivers we share with them.

However, Georgians do not conserve as much water as they can, compared to some other states. Instead of looking for new sources of water, which are very expensive to develop, we should be looking first at conservation, which is a much more cost-effective way to increase available water.

http://www.georgiaplanning.com/watertoolkit/Documents/WaterConservationDroughtManagement/Water%20Conservation%20Tools%20Script.doc

Understanding the Part We Play: OPTION 1
Student Writing Sheet

Expository Writing Topic: Personal Water Conservation Plan

Writing Situation

Humans, plants and animals, all depend on the same water in a river system and we must maintain the overall health of the river system to meet our needs and the needs of the environment. During times of drought, when there is little or no rainfall, the amount of water entering a river system decreases. At the same time, the amount of water we use increases as the result of outdoor watering such as using sprinklers on lawns everyday.

Directions for Writing

Select one of the four organizational patterns – Compare/Contrast; Description; Explanation; or Problem/Solution to write a plan for how YOU can personally conserve water outdoors during a drought. Use the checklist below to guide you as you write.

Student Writing Checklist for Expository Writing

http://www.whitfield.k12.ga.us/testscores/Grade%208%20MGWA/About%20the%20Grade%208%20Writing%20Assessment.doc

Prepare Yourself to Write

- ❑ Read the Writing Situation and Directions for Writing carefully.
- ❑ Brainstorm for ideas.
- ❑ Decide what ideas to include and how to organize them.
- ❑ Write only in English.

Make Your Paper Meaningful

- ❑ Use your knowledge and/or personal experiences that are related to the topic.
- ❑ Explain, clarify, and define your ideas.
- ❑ Establish a clear controlling idea.
- ❑ Fully develop your controlling idea with specific, supporting details.
- ❑ Organize your ideas in a clear and logical order.
- ❑ Write an expository essay and stay on topic.

Make Your Paper Interesting to Read

- ❑ Think about what would be interesting to the reader.
- ❑ Use a lively writing voice that shows your interest in the topic.
- ❑ Use precise, descriptive, vivid words.
- ❑ Vary the type, structure, and length of your sentences.

Make Your Paper Easy to Read

- ❑ Indent to start a new paragraph.
- ❑ Use effective transitions.
- ❑ Write in complete and correct sentences.
- ❑ Capitalize, spell, and punctuate correctly.
- ❑ Make sure your subjects and verbs agree.

Understanding the Part We Play: OPTION 2
G.R.A.S.P Poster: Public Water Conservation Campaign

Goal:
To explain ways to conserve water outdoors, and why water conservation reduces the negative impacts of drought on humans and the environment.

Role:
Your job is to design a public water conservation campaign that will educate the public about outdoor water use and conservation during times of drought. Two other designers have also been asked to submit proposals for this job. If your proposal is selected, you will get a full-time job and the campaign you designed will be launched statewide.

Audience:
Citizens of Georgia

Situation:
Humans, plants and animals, all depend on the same water in a river system and we must maintain the overall health of the river system to meet our needs and the needs of the environment. During times of drought, when there is little or no rainfall, the amount of water entering a river system decreases. At the same time, the amount of water we use increases as the result of outdoor watering such as using sprinklers on lawns everyday. Daily household water use can increase 60% in summer months as the result of outdoor watering (www.conservewatergeorgia.net).

Product:
Design a poster that will attract attention and bring awareness to the public regarding outdoor water use and conservation. Your mock-up must be larger than an 8 x 11 sheet of paper but no larger than a typical poster board. It may represent a newspaper or magazine advertisement, television commercial, or other strategy for reaching the public.

SUGGESTION: Sketch your initial ideas first and share them with your teacher or a trusted critic for feedback before you start on the final product.

Understanding the Part We Play: OPTION 2
G.R.A.S.P Poster: Public Water Conservation Campaign
Student Reading and Discussion Sheet – Page 3

outdoor advertisement

logo

mascot

Understanding the Part We Play: OPTION 2
G.R.A.S.P Poster: Public Water Conservation Campaign
Student Reading and Discussion Sheet – Page 4

flyer

LITTER.
It costs you.
litteritcostsyou.org

Litter. It Costs You.

Take Action! 10 Steps to A Cleaner Georgia

What can I do?

The first and most important thing is to set a good example by *not* littering. Once you've committed to keeping your trash where it belongs, you can also work on the following:

1) Pick up one piece of litter every day.

2) If you haul materials in the back of a truck, be sure to cover your load. Much of the litter on our roadways is accidentally blown out of the back of trucks.

3) Make sure your trash cans have lids that can be securely attached. If you have curbside trash service, don't put out uncovered containers or open boxes filled with trash. Bungee cords work well to hold lids in place.

4) Secure papers before placing them in a curbside recycling bin. Loose papers can be blown out by the wind.

5) Carry a litterbag in your car. Try reusing your plastic grocery bags. They make great car litterbags.

6) If you are a smoker:
   a. As soon as you light up, identify where you will dispose of your cigarette waste. Use a proper ashtray or trash receptacle.

   b. Carry and use a portable or pocket ashtray.

7) Suggest a clean-up as a public service project at your place of work, church or community organization. Check out the Clean Community Challenge or Rivers Alive programs at litteritcostsyou.org.

8) "Adopt" a spot and maintain it on a regular basis, or find out how you can plant and maintain flowers along a curb, sidewalk or in your local park. People litter less where areas have been beautified. Talk to your employer about getting involved in the Adopt-A-Highway program.

9) Find out if your community has a local Keep Georgia Beautiful affiliate and get involved! If not, find out how you can start your own program.

Litter. It Costs You. Department of Community Affairs 60 Executive Park South, NE Atlanta, GA 30329

Three out of four Georgia motorists say they have seen trash thrown out of a vehicle, yet only one in 10 admits to littering from their vehicle.

LITTER.
It costs you.
litteritcostsyou.org

newspaper/magazine advertisement

Understanding the Part We Play: OPTION 2
G.R.A.S.P Poster: Public Water Conservation Campaign

Scoring Rubric

Student Name: _____

CATEGORY	8 points	7 points	6 points	5 points
Graphics - Originality	Several of the graphics used on the poster reflect a exceptional degree of student creativity in their creation and/or display.	One or two of the graphics used on the poster reflect student creativity in their creation and/or display.	The graphics are made by the student, but are based on the designs or ideas of others.	No graphics made by the student are included.
Knowledge Gained Goal: To explain ways to conserve water outdoors, and why water conservation reduces the negative impacts of drought on humans and the environment.	Student can accurately answer all questions related to facts in the poster and processes used to create the poster.	Student can accurately answer most questions related to facts in the poster and processes used to create the poster.	Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster.	Student appears to have insufficient knowledge about the facts or processes used in the poster.
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed. It is not attractive.
Grammar	There are no grammatical mistakes on the poster.	There is 1 grammatical mistake on the poster.	There are 2 grammatical mistakes on the poster.	There are more than 2 grammatical mistakes on the poster.