TRANSPIRATION IN PLANTS

6 - 8

SUBJECTS:
Biology, Botany, Math

TIME:
3 consecutive class periods

MATERIALS:
potted plants
clear plastic bags
balances with gram weights
marker
sheet of graph paper
student sheet
teacher sheet

OBJECTIVES

The student will do the following:

1. Define the hydrologic cycle.

2. Define transpiration.

3. Name the three parts of the hydrologic cycle.

4. Record the amount of moisture given off by several green plants.

BACKGROUND INFORMATION

The hydrologic cycle begins with the evaporation of water from the oceans. The resulting water vapor is transported by moving air masses. Eventually this water vapor may form into clouds that could lead to precipitation.

What happens to all of the rain that falls on the United States in an average day? About 3 percent of this water will seep underground. About 31 percent will run off into rivers, streams, and lakes. About 66 percent of the water returns to the atmosphere through evaporation and transpiration.

Plants take water from the soil through their roots. They release water vapor to the atmosphere through thousands of small holes (called stomata) on the backs of their leaves in a process called transpiration. A big oak tree gives off about 150,000 liters of water a year. While water from streams and lakes evaporates, plants emit water vapor into the air through transpiration at a much higher rate. But the most significant recyclers of water are the Earth's oceans, which absorb solar energy and evaporate (just like water in a glass will). Evaporated water from the ocean becomes water vapor moving along the surface of the ocean. The air above the ocean also warms and rises, starting a convection cell and carrying water vapor with it. As warm air gets higher, it cools. The cooling water vapor turns back into liquid. The change from water vapor to liquid is called condensation.

<u>Terms</u>

condensation: the act or process of reducing a gas or vapor to a liquid or solid state.

evaporation: the act or process of converting or changing into a vapor with the application of heat.

humidity: the degree of wetness especially of the atmosphere.

hydrologic (water) cycle: the cycle of the Earth's water supply from the atmosphere to the Earth and back which includes precipitation, transpiration, evaporation, runoff, infiltration, and storage in water bodies and groundwater.

moisture: a small amount of liquid that causes wetness.

precipitation: water droplets or ice particles condensed from atmospheric water vapor and sufficiently massive to fall to the Earth's surface, such as rain or snow.

transpiration: direct transfer of water from the leaves of living plants or the skins of animals into the atmosphere.

ADVANCE PREPARATION

A. Obtain enough green potted plants so that each group of students has two.

PROCEDURE

I. Setting the stage

A. Show a plant to the students.

B. Ask the students the following questions:

1. How do plants get water?

2. What happens to the water after it gets into the plant?

3. How does the water leave the plant?

4. Where does the water go after it leaves the plant?

5. Do plants contribute to the hydrologic cycle?

6. How do plants contribute to the hydrologic cycle?

7. Discuss the hydrologic cycle and how it works.

II. Activity

A. Divide the students into groups.

B. Give each group two potted plants, a plastic bag with a tie, and a balance.

C. Have the groups do the following:

1. Cover one of their plants with a plastic bag.

2. Tie the bag so that it is air tight.

3. Place the plants on opposite sides of the balance.

4. Make sure the plants are balanced by adding weight (gram) to one side if necessary.

5. Mark one side of the balance A and the other side B.

D. For the next three days, ask the students to observe any differences in the weight of the plants.

E. Students can determine the weight lost through transpiration by recording the number of grams it takes to balance the plants. Record this amount each day and plot it on the graph.

F. Have the students answer the questions below:

1. What do you see on the inside of the plastic bag?

2. Which side of the balance has gone up? Down?

3. Do you think all plants give off the same amount of water?

4. Where is the water that was lost in the plant that was not covered?

5. How does humidity affect water loss?

6. What season of the year will the plants give off the most water? The least water?

7. In what biomes would plants lose the most water? The least?

III. Follow-Up

A. Have the students relate transpiration to the hydrologic cycle and draw pictures showing transpiration as part of the hydrologic cycle.

IV. Extension

A. Have the students conduct the same investigation with various plants such as geraniums and cactuses.

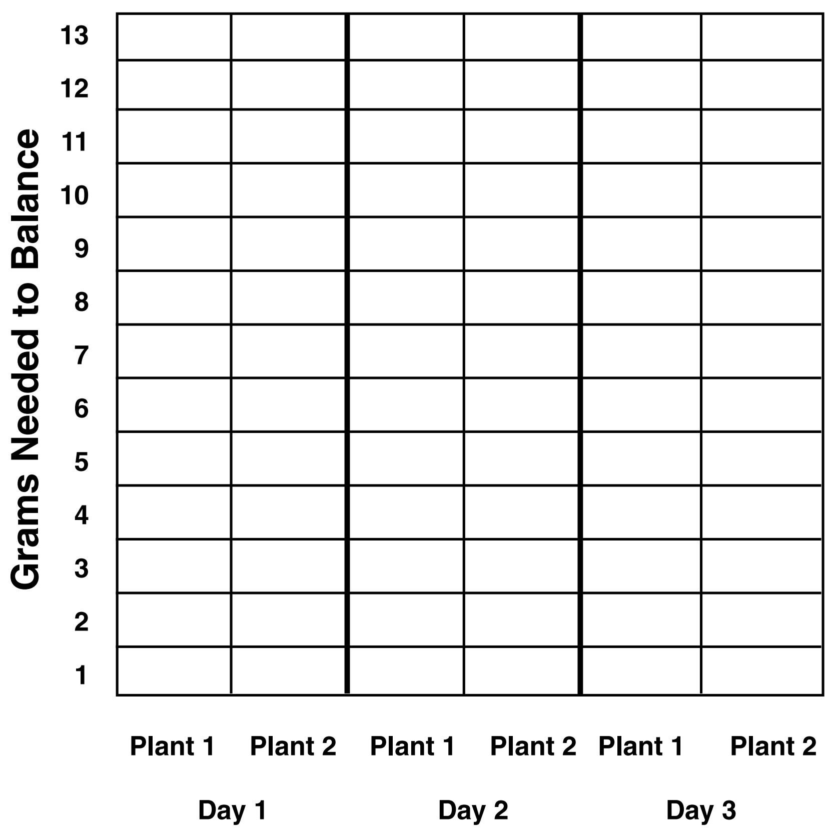
B. Research the climatic conditions and types of plants in various biomes.

RESOURCE

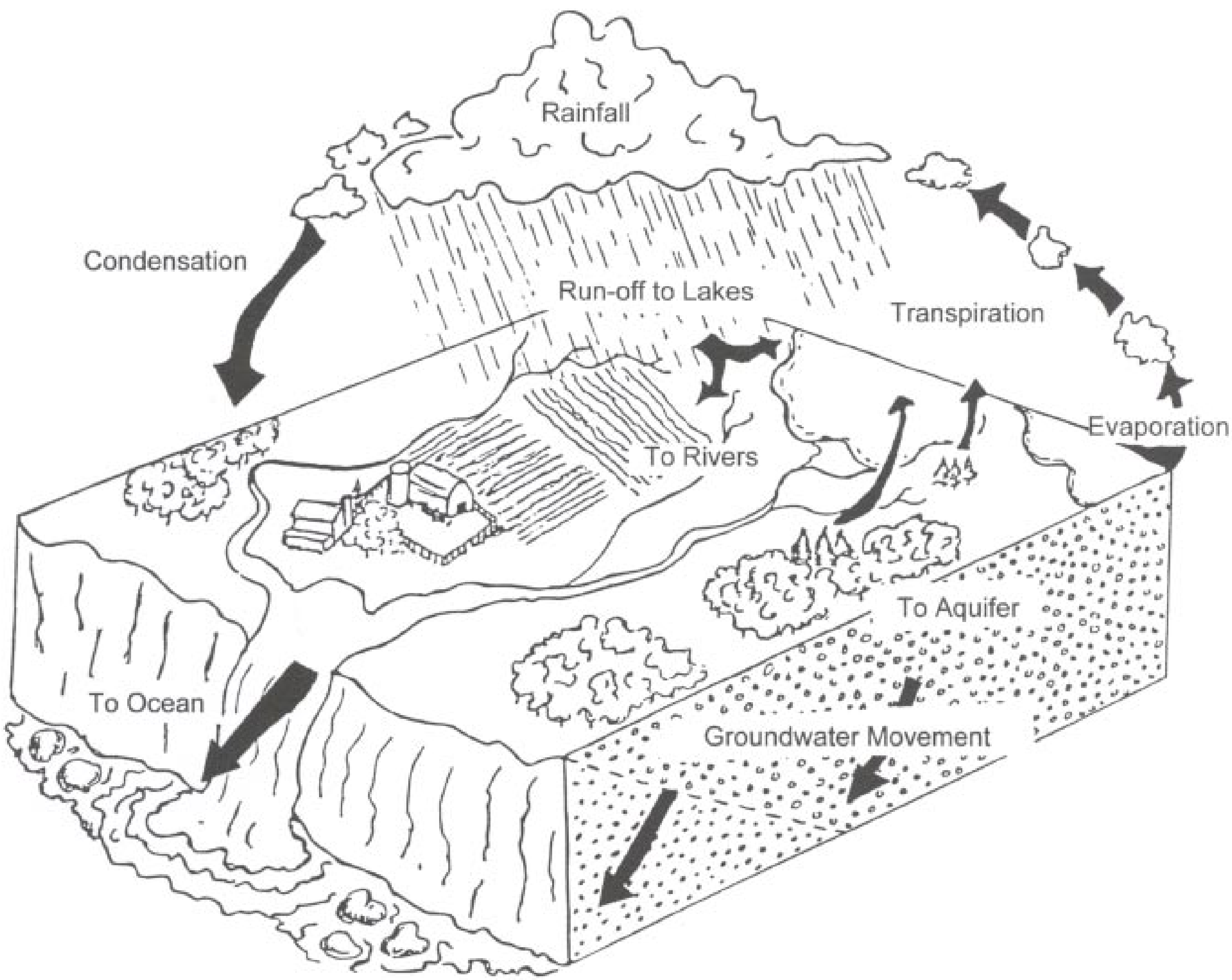
The Water Cycle: http://njnie.dl.stevens-tech.edu/curriculum/recycle.html

Directions: Determine the weight lost through transpiration by recording the number of grams it takes to balance the plants. Record this amount each day and plot it on the graph below.

	Day One	Day Two	Day Three
Plant #1 (enclosed in plastic)			
Plant #2 (without plastic covering)			



Hydrologic Cycle



DESIGN AND CONSTRUCT A TERRARIUM

6 - 8

SUBJECTS:
Biology, Botany, Language Arts

TIME:
50 minutes

MATERIALS:
2 L plastic soft drink bottle
5 cups potting soil
small plants that grow well in moist environments
5 cups of water
scissors
plastic wrap
masking tape
student sheet

OBJECTIVES

The student will do the following:

1. Design and construct a terrarium.
2. Explain the processes of the water cycle.
3. Describe how a closed system works.

BACKGROUND INFORMATION

The distribution of evaporation and precipitation over the ocean (its hydrologic cycle) is one of the least understood elements of the climate system. However, it is now considered one of the most important, especially for ocean circulation changes on decadal to millennial time-scales. The ocean covers approximately 75 percent of the Earth's surface and contains nearly all (more than 97 percent) of its free water. Thus, it plays a dominant role in the global water cycle. The atmosphere only holds a few cubic centimeters of liquid water, or 0.001 percent of the total. However, most discussions of the water cycle focus on the rather small component associated with terrestrial processes. This is understandable, since the water cycle is so vital to agriculture and all of human activity. Yet, current estimates indicate that 86 percent of global evaporation and 78 percent of global precipitation occur over the oceans. Since the oceans are the source of most rain water, it is important for us to work toward a better understanding of the ocean hydrologic cycle. Small changes in ocean evaporation and precipitation patterns may have dramatic consequences for the much smaller terrestrial water cycle. For example, if less than one percent of the rain falling on the Atlantic Ocean were to be concentrated in the central United States, it would double the discharge of the Mississippi River.

Groundwater is an integral part of the water cycle. The cycle starts with precipitation falling on the surface. Runoff from precipitation goes directly into lakes and streams. Some of the water that seeps into the ground is used by plants for transpiration. The remaining water, called recharge water, drains down through the soil to the saturated zone, where water fills all the spaces between soil particles and rocks.

The top of the saturated zone is the water table, which is usually the level where water stands in a well, if the local geology is not complicated. Water continues to move within the saturated zone from areas where the water table is higher toward areas where the water table is lower. When groundwater comes to a lake, stream, or ocean, it discharges from the ground and becomes surface water. This water then evaporates into the atmosphere, condenses, and becomes precipitation, thus completing the water cycle.

Terms

closed system: a system that functions without any materials or processes beyond those it contains and/or produces itself.

terrarium: a box, usually made of glass, that is used for keeping and observing small animals or plants.

ADVANCE PREPARATION

A. Have students complete the terrarium planning sheet.

PROCEDURE

I. Setting the stage

A. Discuss with students what a closed system is and how it works. (Example: an automobile engine)

B. Ask students the following questions:

1. What is a terrarium?

2. Where are they found?

3. Can anyone design a terrarium?

4. Are they expensive to make?

II. Activity

A. The teacher or the students should cut the top off the 2-liter bottle using scissors.

B. Have the students cover the bottom of the bottle with soil.

C. Have the students plant the small plants and water them.

D. Finally, have the students cover the terrarium with a piece of plastic wrap and seal it.

E. Ask the students to observe the terrarium carefully, noting the path of the water through the water cycle.

III. Follow-Up

A. Ask students to compare the way water moves in the terrarium to the steps of the water cycle.

B. Have the students compare their terrariums with those of other students in the class.

C. Students are to make daily observations of their terrariums and record their findings.

D. Ask students to explain what the terrarium observations say about water in our environment. (Answer: Water is never created or destroyed but is continually obtained, used, and recycled by nature—and by humans.)

IV. Extensions

A. Have students predict what would happen to the plants in three months, six months, or even a year.

B. Make a terrarium on a larger scale using a 5-gallon bottled water bottle.

C. Visit a greenhouse.

RESOURCES

Groundwater in the Water Cycle: http://hammock.ifas.ufl.edu/txt/fairs/16848

Fundamentals of the Ocean Water Cycle: http://earth.agu.org/revgeophys/schmit01/node1.html

Daily Observation of a Hydrologic Cycle in a Terrarium

	Observation
Day 1	
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	
Day 7	
Day 8	
Day 9	
Day 10	

Extended Predictions of Hydrologic Cycle in a Terrarium

	Observation
One month	
Two months	
Three months	

Use the space below to summarize your findings:

AQUATIC FOODS

6 - 8

SUBJECTS:
Biology, Health, Social Studies

TIME:
50 minutes

MATERIALS:
pencil
paper
magazines
newspaper
poster
glue
food labels
student sheet

OBJECTIVES

The student will do the following:

1. Identify foods derived from aquatic sources.

2. Describe how the aquatic environment is important to our food sources.

BACKGROUND INFORMATION

Aquaculture is a form of agriculture which involves the propagation, cultivation, and marketing of aquatic plants and animals in a more-or-less controlled environment. Fish farming was first practiced as long ago as 2000 B.C. in China, but United States aquaculture started in the late 19th century. The Bible refers to fish ponds and sluices, and ornamental fish ponds appear in paintings from ancient Egypt. European aquaculture began sometime in the Middle Ages and transformed the art of Asian aquaculture into a science that studied spawning, pathology, and food webs.

The history of aquaculture in the United States can be traced back to the mid-to-late 19th century when pioneers began to supply brood fish, fingerlings, and lessons in fish husbandry to would-be aquaculturists. Until the early 1960s, commercial fish culture in the United States was mainly restricted to rainbow trout, bait fish, and a few warm water species, such as buffaloes, bass, and crappies. The most widely recognized types of aquaculture in the United States are the catfish industry and crayfish farms in the South and the trout farms in Michigan and the West. Both of these industries involve the culturing of a single fish species for food. Another familiar type of aquaculture is the production of bait minnows and crayfish for use by recreational fishermen. There are several categories of production of aquaculture products: 1) food organisms, 2) bait industry, 3) aquaria trade-ornamental and feeder fish, 4) fee fishing, 5) pond and lake stocking, and 6) biological supply houses.

The production of food organisms is the most common form of aquaculture practiced in the United States. Of the approximately 60 species that have the potential to be grown as food fish, technical support and markets limit these to a select few. The most common food fish and shellfish in the United States are catfish, trout, salmon, carp, crayfish, freshwater shrimp, striped bass and its hybrids, and tilapia.

<u>Terms</u>

aquaculture: the science, art, and business of cultivating marine or freshwater food fish or shellfish, such as oysters, clams, salmon, and trout, under controlled conditions.

mariculture: the cultivation of marine organisms in their natural habitats, usually for commercial purposes.

ADVANCE PREPARATION

A. Gather newspapers and magazines.

B. Obtain labels from certain foods.

C. If students want to, they can bring in food.

PROCEDURE

I. Setting the stage

A. Discuss aquaculture and mariculture. (Example: Seaweed, also known as algin or algar, is used as a thickener in ice cream and is also used as a suspension agent in chocolate milk.)

II. Activity

A. Using newspapers and magazines, clip out all foods derived from aquatic environments.

B. Allow students to draw and label the foods from aquatic sources they brought in.

C. Construct a mural or a bulletin board of pictures and advertisements to show aquatic foods and their sources.

III. Follow-Up

A. Ask the following questions using the mural or bulletin board:

1. Where do certain foods come from?

2. How are they obtained?

3. Where and how are they processed?

4. How are they used?

IV. Extensions

A. Research aquaculture and mariculture in the U. S. and other countries.

B. Classify the aquatic food products according to the kinds of aquatic habitats in which they are found: saltwater (ocean, estuary, marsh) and freshwater (lake, pond, river, stream).

C. What environmental requirements must be met for successful aquaculture? How are they met in real-world applications?

D. Keep a list of foods eaten for a week. Classify each as aquatic or not aquatic.

RESOURCES

Western Regional Environmental Education Council 1987, Project Aquatic Wild, P.O. Box 18060, Boulder, CO 80308-8060. (303) 444-2390.

A Basic Overview of Aquaculture: http://info.utas.edu.au/docs/aquaculture/Pages/Swann.html#400

Directions: List in the correct column the foods you eat in a week.

List of Foods Eaten	Aquatic	Non-Aquatic

ON YOUR MARK, GET SET, EVAPORATE

6 - 8

SUBJECTS:
Chemistry, Math

TIME:
50 minutes

MATERIALS:
chalkboard
chalk
sponge
pail of water
salt
clock with second hand
student sheet

OBJECTIVES

The student will do the following:

1. Explain the hydrologic cycle.
2. Explain the terms evaporation, condensation, and precipitation.

BACKGROUND INFORMATION

Evaporation is the main way water on land is transferred to the atmosphere. It is the process whereby liquid moisture is turned into gaseous moisture. Energy is supplied from the sun or atmosphere. This energy causes the water molecules to vibrate faster which causes them to move further apart. As temperatures increase, molecules at the water surface detach and move into the atmosphere. Saturation of the lower atmosphere occurs, dependent upon atmospheric conditions. Cold, humid air undergoing little movement will quickly saturate, but warm, dry air undergoing turbulent mixing as a result of wind will saturate slowly leading to higher evaporation rates.

Factors influencing evaporation:

Meteorological Factors

1. Radiation: This can come directly from the sun or indirectly from the surrounding atmosphere. This causes an increase in the temperature of the air and water.
2. Wind: Evaporation is higher in areas that are open and subject to air movement than in sheltered areas with little movement of the air. Air movement and turbulence is desirable to mix up air and cause saturated lower layers to mix with drier upper air.

Physical Factors

1. Salinity: An increase in salinity leads to a proportional decrease in evaporation rates.
2. Surface Area: As the surface area of the water body increases, the total evaporation increases.

<u>Terms</u>

condensation: the act or process of reducing a gas or vapor to a liquid or solid state.

evaporation: the act of converting or changing into a vapor with the application of heat.

hydrologic (water) cycle: the cycle of the Earth's water supply from the atmosphere to the Earth and back which includes precipitation, transpiration, evaporation, runoff, infiltration, and storage in water bodies and groundwater.

precipitation: water droplets or ice particles condensed from atmospheric water vapor and sufficiently massive to fall to the Earth's surface, such as rain or snow.

ADVANCE PREPARATION

A. Assemble all of the materials you will need for this activity.

PROCEDURE

I. Setting the stage

A. Fill a glass full of water.

B. Set it on a table close to a heat source.

C. Show the students the glass of water.

1. Ask the students what they think will happen to the water over a period of time.

2. Ask them to explain the process of evaporation.

3. Ask the students what they think will happen to a glass of oil, coca cola, and syrup over time.

II. Activity

A. Distribute the student sheets. Divide the class in half and get two volunteers to come to the chalkboard. Two other volunteers will watch a clock.

B. Have the volunteers draw a circle about two feet in diameter on each half of the blackboard. Provide the two volunteers with a wet sponge.

C. Ask the volunteers to stand in front of the circles. When you say “go,” the volunteers will then wet the circle with a sponge.

D. The students who are seated will observe the spot and alert the clock person when their spot is completely dry. The volunteers with the clocks have to immediately stop the clocks when their spot dries.

E. The race is run 2 out of 3 times. The best 2 out of 3 wins.

III. Follow-Up

A. Ask the students the following questions:

1. What happened to the water that the volunteers wiped on the board?

2. Where did the water go?

3. Do you think various substances diluted in water would affect the rate of evaporation?

4. Think of ways to make the water evaporate faster. (Shining a hot light on the circle, using a fan, etc.)

5. What are natural occurrences or results of evaporation? (Answer: lowering of lake levels during warm, dry periods.)

6. What happens within streams and lakes with evaporation relative to pollutants? (Answer: pollutants concentrate.)

IV. Extensions

A. Use saltwater instead of freshwater to conduct the above race.

B. Use alcohol.

RESOURCES

Siepak, Karen L. Water. Carson-Dellosa Publishing Company, Inc., Greenboro, NC, 1994.

Hackett, Jay & others. Science, Merrill Publishing Co., Columbus, OH, 1989.

Evaporation: http://giswww.king.ac.uk/aquaweb/main/evaporat/evapo1.html

Directions: Complete the following chart.

Time it takes for the water to evaporate:

	Race #1	Race #2	Race #3
Volunteer #1			
Volunteer #2			

Time it takes for the alcohol to evaporate:

	Race #1	Race #2	Race #3
Volunteer #1			
Volunteer #2			

SUMMARY:

Explain the results in the space below:

ENVIRONMENTAL VEHICLE PLATE MESSAGES

6 - 8

SUBJECT:
General

TIME:
30 minutes

MATERIALS:
"license plates" made up with shortened environmental terms and phrases
activity sheet
poster board
pens/markers
student sheets

OBJECTIVES

The student will do the following:

1. Decode hidden messages on imaginary vehicle plates.
2. Create plate twisters dealing with water topics.

BACKGROUND INFORMATION

This activity is appropriate for any unit on water. This activity uses any terms that relate to water, such as river, hydrologic cycle, precipitation, runoff, watershed, reservoir, etc., and relates them to the growing popularity of environmental license plates and personalized messages unique to each owner. See the Glossary or other activities for more ideas.

<u>Terms</u>

watershed: land area from which water drains to a particular water body.

hydrologic (water) cycle: the cycle of the Earth's water supply from the atmosphere to the Earth and back which includes precipitation, transpiration, evaporation, runoff, infiltration, and storage in water bodies and groundwater.

precipitation: water droplets or ice particles condensed from atmospheric water vapor and sufficiently massive to fall to the Earth's surface, such as rain or snow.

reservoir: a body of water collected and stored in a natural or artificial lake.

groundwater: water that infiltrates into the Earth and is stored in usable amounts in the soil and rock below the Earth's surface; water within the zone of saturation.

hydroelectric: that generation of electricity which converts the energy of running water into electric power.

conservation: act of using the resources only when needed for the purpose of protecting from waste or loss of resources.

runoff: water (originating as precipitation) that flows across surfaces rather than soaking in; eventually enters a water body; may pick up and carry a variety of pollutants.

ADVANCE PREPARATION

A. Discuss the topic of water and the many ideas it encompasses.

B. Have the license plates already made up. These may be done on a poster board or placed on a worksheet. At the end of this exercise is a sample worksheet that you may administer to your students.

PROCEDURE

I. Setting the stage

A. Show the students a sample license plate and ask if they can decipher the hidden message.

B. Explain to the students that they will be playing a game to see how many hidden messages they can correctly reveal on the license plates.

C. This activity can be done individually or with a partner. Remind them that it will be a timed activity. The first to decode the hidden messages correctly will be the winner. You may want to have a prize for the winner.

II. Activity

A. Individual work

1. Pass out the activity sheet to all students and begin timing. Have students decode the messages and define the term or explain the process.Call time and have students count the number they got correct.

2. Have students create their own messages based on water terms. They can trade with other students or groups and decode each other's messages.

B. Group work

1. Hold up the first plate to the first pair of partners. The students will try to decipher the message within 30 seconds. If they get the plate correct, they receive a point. If they miss the answer, Team 2 gets a chance, and so on through the other teams.

2. The game ends depending upon the teacher's discretion and time.

C. Key to plates:
1. Ground water
2. Hydrologic cycle
3. Water vapor
4. Point source pollution
5. Condense
6. Evaporate
7. Conserve
8. Water bird
9. Molecule
10. Conserve water
11. Watershed

III. Follow-Up

A. Have the students make up their own plate messages. They may want to play a round of the game with their license plate ideas.

B. Make a bulletin board of all the plate messages to be shared with other classes.

IV. Extensions

A. Students may write the words and phrases in complete sentences.

B. Have the students compile all of their plate messages and make a booklet.

C. Over a specified time period, have students collect plate messages they observe on the roads during their daily routines.

D. Have the students write to their local license commissioner for a list of creative license plates.

RESOURCES

State Agencies (Revenue, Licensing, Finance Departments).

Directions: Please decode the following vehicle license plate plates.

1) G Water ____________________

2) Hydro C ____________________

3) Water V ____________________

4) P S Poll ____________________

5) C dense ____________________

6) va p rate ____________________

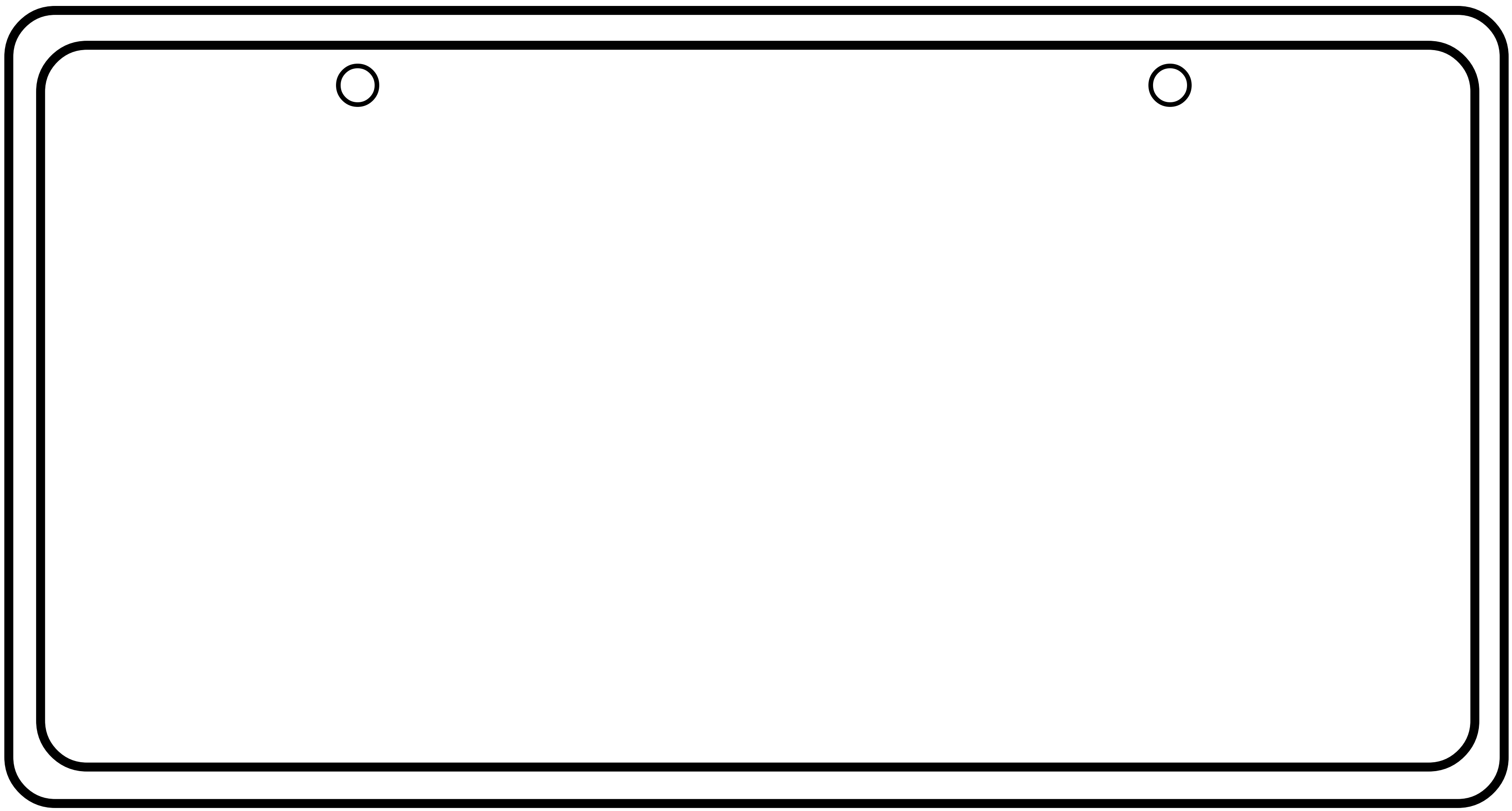
7) C serve ____________________

8) Wa Bird ____________________

9) Mo cule ____________________

10) Con H2O ____________________

11) Water S ____________________



NUTRIENTS AND WATER QUALITY

6 - 8

OBJECTIVES

The student will do the following:

1. List changes in water conditions caused by various pollutants, such as household chemicals, that often end up in aquatic environments.

2. Describe potential effects on animals and plants caused by these pollutants.

3. Classify sources of pollution.

SUBJECTS:
Biology, Ecology

TIME:
Takes place over the course of about one month. Set up approximately two weeks ahead of experiment.

MATERIALS:
5 clear 1-qt or larger containers (plastic soda bottles or canning jars)
water with algae from a freshwater pond or purchased from a supply house
plant food
aged tap water (allow to sit about 48 hours)
light source (direct sunlight or strong artificial light)
pollutants: cooking oil (colored red), detergent (not green), vinegar
camera and film (optional)
student sheet

BACKGROUND INFORMATION

Two nutrients that are essential for the growth and metabolism of plants and animals are nitrogen (N), and phosphorus (P). Plant growth depends on the amount of phosphorus available. Phosphorus is present in low concentrations in numerous bodies of water, so it is a growth-limiting factor. Since nitrogen is found in several forms, it is frequently more available than phosphorus. Nitrogen is used by plants to make plant proteins, which animals convert into their own proteins when they eat the plants.

Even though nutrients are needed, too much nutrient material in the water can cause pollution. Algae use up phosphorus quickly. When there is excess phosphorus, a vast growth of algae called an algal bloom can occur. The water may then look like pea soup. The algae rob the water of oxygen needed to sustain life. Some forms of nitrogen can cause similar problems in water.

There are several ways that excess nutrients get into the water. Both nitrogen and phosphorus are part of living plants and animals and become part of organic matter when the plants and animals die and decompose. Nutrients come from human, animal (including pet), and industrial wastes. Other sources of nutrients are human activities that disturb the land and its vegetation, such as road and building construction, farming, and draining of wetlands for development. Normally, nutrients are held in the soil and stored in the wetlands. When soil erodes and washes away, it carries the nutrients along until it ends up in the water. If wetlands are drained for development, they can no longer filter nutrients from runoff.

<u>Terms</u>

nutrient: an element or compound, such as nitrogen, phosphorus, and potassium, that is necessary for plant growth.

algal bloom: a heavy growth of algae in and on a body of water; usually results from high nitrate and phosphate concentrations entering water bodies from farm fertilizers and detergents; phosphates or algal blooms also occur naturally under certain conditions.

point source pollution: pollution that can be traced to a single point source, such as a pipe or culvert (Example: industrial and wastewater treatment plant discharges).

nonpoint source pollution (NPS): pollution that cannot be traced to a single point, because it comes from many individual places or a widespread area (Example: urban and agricultural runoff).

ADVANCE PREPARATION

A. Set up jars at least two weeks before the experiment begins. Explain to the class that they are setting up model water environments for an experiment to be done later. Plants in a wetland or other aquatic system need nutrients to grow. Nutrients are found in all natural systems. Fill the jars with aged tap water. Add one teaspoon of plant food to each jar and stir well.

B. To improve the quality of the model, use pond water or try adding a bit of soil from a pond or aquarium gravel along with the water. Place the jars in a window where they will get good indirect light or light provided by an incandescent or fluorescent light source. The jars should not be placed in a cold location.

C. Explain to the students that they will be using the model aquatic environments to test the effects of certain pollutants that come from home. Students should decide on household products to use—products that they feel are used frequently, are often dumped down the drain, and thus end up in waterways. Students should bring samples of these materials from home.

PROCEDURE

I. Setting the stage

A. Begin with a classification exercise explaining that students are to organize what they already know about pollution. Some water pollution comes from specific sources such as drains, pipes, effluent from industry—outfalls. This is called point source pollution. Other kinds of pollution come from many widespread sources and are called non-point source pollution. Write these terms on the chalkboard making two columns. Have students suggest things that pollute the water and place them in categories in the chart.

B. Explain that students will conduct pollutant tests with the models set up two weeks ago.

II. Activity

A. Take out the jars, which by now should have algae growing in them. Have the class decide on three safe pollutants to test—use more plant food for the fourth jar, use the fifth jar as a control. When the class has decided what to test, add the materials to the four jars. Add a reasonable amount: two tablespoons of a strong detergent; enough oil to just cover the surface; 1/4–1/2 cup of vinegar; one or two teaspoons of plant food. Ask students to explain how each pollutant could get into the environment in real life.

B. Leave the jars in the light as before. Have the students write their predictions as to what will happen in each container. Photograph the jars (with labels and dates showing) two or three times each week for several weeks.

III. Follow-Up

A. Results will depend on the type of pollutant used.

1. Some pollutants, such as the plant food, favor plant growth and will cause an algal population explosion. This is not healthy since it disrupts the balance of organisms. When the algae die and decompose, oxygen is used up. Ask students to name some plants and animals that would be affected by this situation. Oysters and clams would suffocate because they are unable to move to another location to get more oxygen. A thick mat of algae will block out sunlight needed by other plants.

2. Other pollutants, such as acids, would cause the water to be clear since everything in the water would be killed.

3. The sample with the oil spill may surprise students. If the algae have enough sunlight, they may produce enough oxygen to keep things alive below the oxygen-impervious oil layer. Ask students to consider the effects of a larger spill—ducks and other birds would become coated with oil and not be able to fly, fish gills would be clogged, etc. Ask the students for their conclusions.

B. Human activities which result in water pollution can affect the water environment in ways that are disastrous for natural communities. Some nutrients are necessary for an aquatic habitat, but having too many is harmful. Have the students explain how.

IV. Extensions

A. Ask students whether or not they can devise a method to reverse the pollution in their models. (Example: Add baking soda to the acid model to neutralize the acid, which is similar to adding limestone rocks to lakes or streams to lessen the effects of acid rain. Example: Mop up the oil spill with sawdust, cotton, etc. Could students skim off the oil from their model and let oxygen through again?)

B. Discuss ways to keep pollutants from reaching the water and ways to reduce the amounts that do get through.

RESOURCES

"What's In the Water?" Living In Water, pp. 55-57.

WOW!: The Wonders of Wetlands, pp. 80, 87-89.

Directions: Record your observations of changes in water conditions caused by pollutants.

	3 days	6 days	9 days	12 days	15 days	18 days	21 days
Jar #1 (1 tsp. plant food added — pollutant added is motor oil)							
Jar #2 (1 tsp. plant food added — pollutant added is strong detergent)							
Jar #3 (1 tsp. plant food added — pollutant added is vinegar)							
Jar #4 (1 tsp. plant food added — pollutant is 2 more tsp. plant food)							
Jar #5 (1 tsp. plant food added — no pollutant added. This is the control.)							

WATER RESOURCE PROBLEMS: TOO LITTLE WATER

6 - 8

SUBJECTS:
Earth Science, Ecology, Social Studies

TIME:
50 minutes

MATERIALS:
soil
gravel
sand
pebbles
bedding plants
shallow pan
water
student sheets

OBJECTIVES

Students will do the following:

1. Make a model of a drought.

2. Explain why water is our most abundant resource.

BACKGROUND INFORMATION

Human activities are causing environmental changes that can directly affect global conditions and global politics. During the late 19th and 20th centuries, modern civilization began to degrade the quality and viability of global ecosystems through air and water pollution, changes in atmospheric trace-gas levels, and massive development projects that directly affect ecological balances. Such degradation alters the quality and quantity of resources such as freshwater, genetic reserves, and agricultural soils. These impacts, in turn, can affect political and security relationships, as demonstrated by recent events in Somalia and northern Africa, friction over acid rain, water pollution, and shared rivers throughout the world, and growing global concern about climatic changes and depletion of stratospheric ozone. Future international tensions and conflict may thus come to depend as much on environmental and resource pressures as on the geopolitical inclinations of nations.

Terms

desalination: the purification of salt or brackish water by removing the dissolved salts.

drought: a lack of rain or water; a long period of dry weather.

groundwater: water that infiltrates into the Earth and is stored in usable amounts in the soil and rock below the Earth's surface; water within the zone of saturation.

water conservation: practices that reduce water use.

ADVANCE PREPARATION

A. Prepare separate containers of soil, gravel, small stones, pebbles, and sand.

B. Gather all materials for groups of four.

C. Select a nice warm place (plenty of sunshine) around the building (undisturbed) to leave the activity materials for 4 to 5 days.

D. Review the general steps of conducting scientific investigations with students. Later they will write up their investigations using these steps.

   1. Define the problem

   2. Formulate the hypothesis

3. Collect information or data.

4. Test the hypothesis.

5. Analyze the results.

6. Formulate a tentative conclusion. Stress that conclusions are tentative based on the procedures that were followed in this specific investigation. Results may turn out differently if the investigation was done at another time in another place. To get more accurate results, scientists repeat investigations several times and get an average.

PROCEDURE

I. Setting the stage

A. Have students bring in plants, or ask nearby nursery to donate bedding plants.

B. Work near running water.

II. Activity

A. Have the students do the following:

1. Place equal amounts of sand, soil, gravel, and pebbles in a shallow baking pan. Start with the largest size material and put it on the botton. This should be the gravel unless the pebbles are larger. Make this the first layer. Then add the next largest material ending with the soil as the top layer.

2. Add small stones to the pan.

3. Add plant life to the pan and sprinkle with water.

4. Set pan aside for 4 or 5 days.

5. Make observations daily and record them on the data chart.

III. Follow-Up

A. Have students write up the activity following the steps of scientific investigation.

B. Have students do research on droughts.

C. Research different water requirements of various plants.

D. Assign research papers on each of the topics in the background information.

IV. Extensions

A. Repeat the investigation using different plants. Use plants with a wide range of adapatability such as succulents and broad - leafed plants.

B. Call a plant nursery and find out about their watering practices. When do they water? How long do they water? Which plants need the most water? Which plants need the least amount of water?

C. Repeat the investigation with the same kinds of plants but leave one in the pot or pan and plant the other in the ground. What differences are there in how often the plant needs to be watered?

RESOURCE

Arms, Karen, Environmental Science, Holt, Rinehart and Winston, Orlando, FL, 1996.

Directions: Observe your plants each day and record your observations.

DAY	OBSERVATIONS
1	
2	
3	
4	
5	

WATER RESOURCE PROBLEMS: TOO MUCH WATER

6 - 8

SUBJECTS:
Earth Science, Ecology, Geology

TIME:
50 minutes

MATERIALS:
soil
gravel
small stones
pebbles
bedding plants
shallow pan
water
beaker (baby food jars for water)
student sheet
teacher sheet

OBJECTIVES

The student will do the following:

1. Explain what happens to various areas that are flooded.
2. Measure the amount of water required to saturate and supersaturate a soil sample.

BACKGROUND INFORMATION

Some countries have enough annual precipitation, but they get most of it at one time of the year. More than 2,000 cities world wide are located completely or partially on flood plains suffering floods on an average of once every two to three years. (This is a statistical average. Major floods may occur three times within a month, annually for five consecutive years, or not for several hundred years.)

Flooding is disastrous. It has become more severe over the years. It causes billions of dollars in property damages. People die by drowning and snakebite. Some are left homeless. Hundreds of thousands contract diseases such as cholera and typhoid fever from contaminated water and food supplies.

Floods occur when a watershed receives so much water that its waterways cannot drain it off properly. A watershed is an area of land (usually quite large) over which water drains into a river or stream. A small river will drain several thousand or hundreds of thousands of acres of land. Within any one watershed, excess rain will cause increased water levels downstream. What occurs at any point along a river can affect not only that point but also the entire watershed.

To minimize the effects of a flood, engineers build levees to constrict the overflow of rivers. As more communities build levees, the water in a river is forced to flow at a higher rate because it cannot spread out. As the water flows at a higher rate, it alternatively erodes and deposits sediment and alters the riverbed. The situation worsens as the water rushes downstream. The water level can only continue to rise, eventually spilling over the levees. During prolonged periods of flooding, many levees give way because they are under pressure from the swollen river and are being undercut by water seepage.

Floods in undeveloped areas are not as damaging as the floods in developed areas. First of all, many natural areas have thousands of acres of wetlands which act as giant sponges to soak up excess water. Second, many rivers overflow into the floodplain—a low, flat area on either side of the river. If a river is allowed to spread out onto its floodplain, the flow downstream is slowed. A river's floodplain can accommodate huge amounts of water which are diverted from the main channel and held back. Allowed to flood in this way, the river creates less damage downstream. If humans do not interfere with it, a stream or river produces its own flood control system

Floods are the most frequent and most lethal natural disasters. Ninety-seven percent of the Earth's water is in the oceans; only 0.014% is in lakes, rivers, soil, and the atmosphere. Floods occur when a larger than normal amount of water moves through an area without adequate natural or human-made barriers, or the soil capacity to accommodate the water. This large amount of water may result when previously controlled large bodies of water escape their boundaries or may result from rainfall, melted snow or ice, sea surges, and accidental damming. A high tide combined with an atmospheric depression can cause the seas to flood low lying areas. The majority of floods, called flash floods, happen unpredictably after a big rain. A cubic foot of water weighs 62 pounds. Sand and clay mixed with the water increases force. Most damage results from the impact of moving water and the objects carried by it. In 1969, the National Weather Service began predicting flash floods. Potential flooding is predicted using automatic rainfall gauges, radar, and human observation. Stilling wells, which measure small changes in river height, are also used.

Terms

flooding: an overflowing of water, especially over land not usually submerged.

floodplain: a low, flat area on either side of a river that can accommodate large amounts of water during a flood, lessening flood damage further downstream.

precipitation: water droplets or ice particles condensed from atmospheric water vapor and sufficiently massive to fall to the Earth's surface, such as rain or snow.

saturation: the state of being infused with so much of a substance (Example: water) that no more can be absorbed, dissolved, or retained.

supersaturation: the state of being infused with more of a substance (Example: water) than is normally possible under given conditions of temperature and pressure.

ADVANCE PREPARATION

A. Prepare container with sand, gravel, pebbles, and small stones.

B. Gather enough materials for groups of four.

C. Work near running water.

PROCEDURE

I. Setting the stage

A. Discuss with students the key terms.

B. Explain that floods are disastrous.

C. Have students suggest ways to prevent or reduce flood damage.

II. Activities

A. Divide the students into groups of four.

B. Give each group the following: sand, soil, gravel, small stones, pebbles, bedding plants, shallow pan, and a beaker with water.

C. Have students do the following:

1. Place equal amount of sand, gravel, small stones, pebbles, and soil in the shallow dish.
2. Arrange the plants throughout the soil mixture.
3. Saturate the soil mixture with water. Make and record observations.
4. Supersaturate the soil mixture, make observations, and record.

III. Follow-Up

A. Have students write up the activity, utilizing the steps of the scientific method.

B. Have students list reasons why flooding is disastrous.

C. Have students list various flood management/control methods.

IV. Extension

A. Research areas in the US and worldwide that have experienced devastating floods. Find out how many people died and what the estimated amont of damage was in dollars. Indicate the flooded areas on a map.

RESOURCES

American Water & Energy Savers, Inc.: http://www.americanwater.com/49ways.htm

Miller, Tyler, Living in the Environment, Wadsworth Publishing Co., Belmont, CA, 1990.

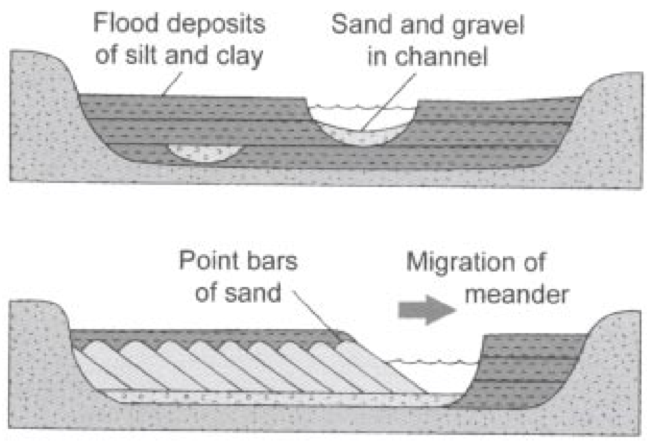
Monorama Talaiver, author: Floods: http://ms.mathscience.k12.va.us/lessons/weather/flood.html

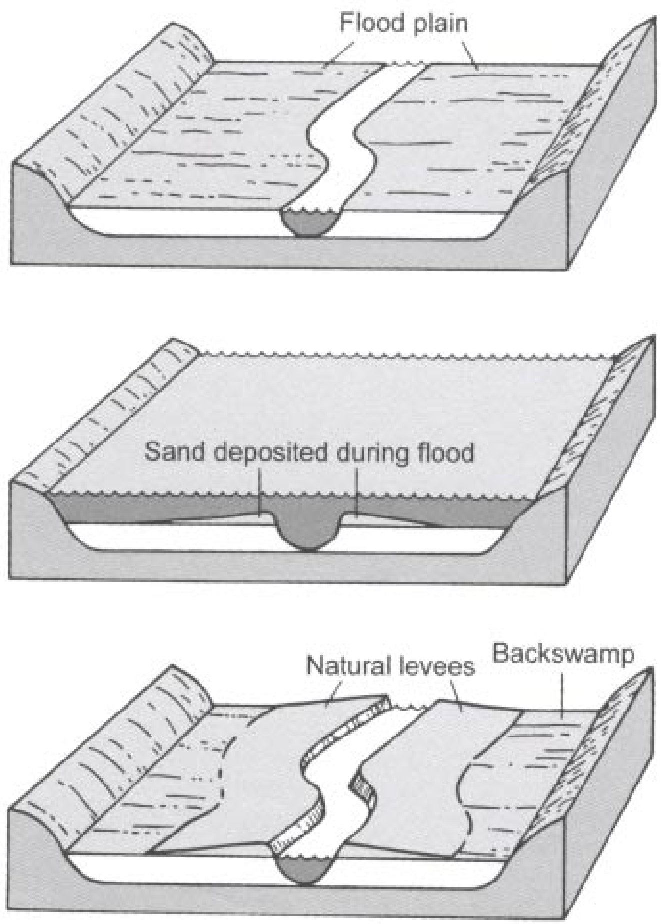
Newton's Apple: Floods: http://132.230.36.11/schule/earthquake/floods.html

Pacific Institute: Water and Sustainability: http://www.igc.apc.org/pacinst/progs.html#

U.S. Army Corps of Engineers District Offices

DAY ONE	**Soil Type:**	**Observations:**
	Saturated	
	Supersaturated	
DAY TWO	**Soil Type:**	**Observations:**
	Saturated	
	Supersaturated	
DAY THREE	**Soil Type:**	**Observations:**
	Saturated	
	Supersaturated	
DAY FOUR	**Soil Type:**	**Observations:**
	Saturated	
	Supersaturated	
DAY FIVE	**Soil Type:**	**Observations:**
	Saturated	
	Supersaturated	


Flood deposits
of silt and clay
Sand and gravel
in channel
Point bars
of sand
Migration of
meander


Flood plain
Sand deposited during flood
Natural levees
Backswamp

WATER CAREER FAIR

6 - 8

SUBJECT:
Biology, Chemistry, Physical Science

TIME:
3 class periods

MATERIALS:
student sheet

OBJECTIVES

The student will do the following:

1. Identify different water-related careers that work specifically with water.

2. Design a career fair exhibit to showcase careers related to water.

BACKGROUND INFORMATION

If someone asked you to name the different careers that are related to water, you might immediately think of a marine biologist or someone in the Navy or Coast Guard. Perhaps you might even think of one who works with different sea animals that are held in captivity. However, these are only a few water-related careers. Some examples of workers in water-related jobs are weather forecasters, landscape architects, and nursery workers. Consider the oil rig worker that helps build and maintain off-shore oil rigs. What about the operators for wastewater treatment plants whose duties include testing water samples and maintaining equipment? Consider also those who work daily to assure that toxic waste does not reach our drinking water supply, or the meter reader who determines how much water we use. There's also the meteorologist, climatologist, or aqueduct builder. The list is endless. Our lives are maintained and surrounded by water. A water-related career is probably one of the most important careers one could choose.

<u>Terms</u>

hydraulic: operated, moved, or brought about by means of water.

ADVANCE PREPARATION

A. Gather materials needed for students to build an exhibit on their selected careers.

PROCEDURE

I. Setting the stage

A. Discuss different water-related careers and how each one relates to students personally. Use as many visuals as possible, including pictures, videos, speakers, etc.

   1. Ask students to name different types of water-related careers.

   2. Ask students if they know someone who works in this area.

II. Activity

A. Have students research the topic of "water-related careers." Guide students as to how to do this. For example, have them look up marine biologist in an encyclopedia or dictionary, or have students interview an individual in a water-related career.

   1. Students should generate their own questions for the interview, asking at least ten questions. Some sample question areas are listed below:

      a. Educational background or training

b. Salary range

c. Daily responsibilities and duties

d. Amount of travel involved

e. Location of most work opportunities

B. Have students create a poster or backboard that provides information about the career.

III. Follow-Up

A. Have students design exhibits and hold a water-career fair using the library where other students can view their projects.

IV. Extensions

A. Take a field trip to a water or wastewater treatment plant or another type of water facility.

B. Have speakers come in.

C. Consider businesses that might allow students interested in certain careers to “shadow” someone working there for one day. This would enable the students to see the daily responsibilities of that particular career.

RESOURCES

Biological Science. Green, 1994.

Earth Science. Holt, 1994.

WATER-RELATED CAREERS

Agricultural Engineer
Aquarium Director
Archaeologist
Aquatic Entomologist
Biologist
Biosolids Specialist
Boat Builder
Boater
Botanist
Bottled Water Company Employee
Builder
Chemist
Chemical Engineer
Civil Engineer
Coast Guard
College/University Professor
Commercial Fisherman
Computer Scientist
Desalination Plant Director
Diver
Docks Master
Ecologist
Environmental Attorney
Environmental Chemist
Environmental Engineer
Environmental Scientist
Farmer
Fire Fighter
Fisheries Biologist
Forester
Geographer
Geologist
Groundwater Contractor
Health Dept./Environmental Inspector
Hydraulic Engineer
Hydrologist
Ice Skater
Landscape Artist
Landscape Architect
Limnologist
Malacologist
Marina Owner/Operator or Employee
Marine Salvage Engineer
Marine Geophysicist
Marine Geologist
Marine Conservationist
Marine Explorer
Marine Technician
Merchant Marine
Meteorologist
Motor Sailboater
Navy
Oceanographer
Olympic/Professional Swimmer
Photographer
Physical Scientist
Plant Physiologist
Plumber
Potter
Professional Tournament Fisherman
Professional Skier (Water or Snow)
Rafting Guide
Ranger
Recreation Instructor
Science Teacher
Scuba Diver
Ship Builder
Seaman
Snow Hydrologist
Soil Scientist
Structural Engineer
Submariner
Sunken Treasure Hunter
Tugboat Biologist
Underwater Photographer
Wastewater Treatment Engineer
Water Meter Reader
Water Level Controller
Water Resources Engineer
Water Quality Control Officer
Well Driller
Yachtsman
Zoologist

WATER EVAPORATION

6 - 8

SUBJECTS:
Chemistry, Math

TIME:
50 minutes

MATERIALS:
pan balance
cellulose sponges
scissors
plastic sandwich bag
spotlight
hot water
cold water
electric fan
petri dishes
student sheets

OBJECTIVES

The student will do the following:

1. Determine the different factors that affect evaporation rate.

2. Brainstorm to come up with ideas to solve a problem.

3. Employ the scientific method while designing and conducting an experiment.

BACKGROUND INFORMATION

Water Evaporation
See "Transpiration in Plants" activity for information on water evaporation.

Humidity is the water vapor or moisture content always present in the air. Humidity can be defined in two ways:

1. Absolute humidity is the weight of water vapor per unit volume of air, pounds per cubic foot or grams per cubic centimeter.

2. Relative humidity (RH) is the ratio of the actual partial vapor pressure of the water vapor in a space to the saturation pressure of pure water at the same temperature. Relative humidity is the commonly accepted measurement of the moisture content in the air.

In simpler terms, relative humidity may be considered as the amount of water vapor in the air compared to the amount the air can hold at a given temperature. Warm air can hold more moisture than cold air. For example, 10,000 cubic feet of 10 degrees F air can hold 5,820 grains of moisture representing a relative humidity of 75 percent. If this air is heated to 70 degrees F, it will still contain the same 5,820 grains of moisture. When it is at 70 degrees F, 10,000 cubic feet of air can potentially hold 80,550 grains of moisture; however, the 5,820 grains it actually holds gives it a relative humidity of about 7 percent.

When humidity is low (less than 40 percent RH), air seeks to draw moisture from any available source. Dry air can make one feel "cold" in a warm room. Moisture evaporates readily from the skin and leaves a feeling of chilliness even with the temperature at 75 degrees F or higher.

When humidity is high (>60 percent), the humid air tends to make people feel that their environment is warmer than it really is. An area at 72 degrees F and 60 percent or greater RH feels warmer than an area at 72 degrees F and 40 percent RH; this is because the evaporative cooling of the body through perspiration is reduced by the high RH of the surrounding air.

<u>Terms</u>

evaporation: the act or process of converting or changing into a vapor with the application of heat.

molecules: the smallest portions of a substance having the properties of the substance.

saturated air: air that contains as much moisture as it is possible to hold under existing conditions.

humidity: the degree of wetness, especially of the atmosphere.

condensation: the act or process of reducing a gas or vapor to a liquid or solid state.

cloud: a visible mass of tiny bits of water or ice hanging in the air usually high above the Earth.

ADVANCE PREPARATION

A. Students must plan for a control on the factor they are going to test. Remember—the control is to be treated exactly like the variable. Use only one factor to test the variable.

B. Students should write down and be prepared to discuss all steps in the scientific method except stating the problem. (The problem was presented to them.)

PROCEDURE

I. Activity

A. Use one of the factors listed in the student sheet and the materials given to design and carry out an experiment to prove or disprove your prediction for the stated problem. The factors are wind, humidity, water, temperature, or surface area.

1. Record the steps of your experiment.

2. Record the results of your experiment. Remember to weigh all sponges before and after use.

B. Compare your results with other groups who are testing the same factor.

C. All groups share the results with the entire class using the charts.

D. Answer the following questions.

1. Which factor had the fastest evaporation rate? Why? The slowest rate? Why?

2. How would the above factors influence the different oceans of the world?

3. Explain how winter, spring, summer, and fall affect the evaporation rate.

III. Extensions

A. Have students construct an iceberg. Fill a balloon with tap water and freeze overnight. The next day peel the rubber off and place the iceberg in a clear container filled 1/2 full of water. Answer the following questions:

1. How much of the iceberg is above the water? Below the water?

2. Why are icebergs very dangerous to ships?

B. Write reports on famous shipwrecks.

C. Watch the movie, *The Poseidon Adventure*.

D. Do the Word Search (attached).

RESOURCES

Oceans in Motion, MacMillan / McGraw-Hill, 1995.

Humidity: Friend or Foe, by Enviros: The Healthy Building Newsletter.

Directions: Design and conduct an experiment.

Selected Factor (circle one)	Prediction		
Sun's Energy Wind Humidity Water Temperature			
	Surface Area-Sponge	Weight Before	Weight After

List and number the steps you will follow in your experiment.

1.

2.

3.

4.

5.

6.

INFLUENCE ON EVAPORATION RATE

Sun's Energy	Wind	Humidity	Water Temperature	Surface Area

Explain the results of your experiment.

Directions: Answer the following after conducting your experiment.

1. Which factor had the greatest evaporation rate? Why?

2. Which factor has the slowest evaporation rate? Why?

3. How would the above factors influence the different oceans of the world?

4. Explain how winter, spring, summer, and fall affect evaporation rate?

WORD SEARCH

C	E	G	M	K	B	L	D	M	O	H	R	R
O	R	T	O	U	J	C	L	O	U	D	I	K
N	E	K	L	Z	W	B	C	M	D	Y	A	E
D	R	A	E	I	R	Z	I	I	B	Z	D	T
E	E	K	C	G	E	D	L	R	O	E	B	A
N	H	M	U	P	F	O	M	K	T	M	K	R
S	P	I	L	E	S	P	Z	A	E	O	E	O
A	S	O	E	C	U	L	R	E	A	T	E	P
T	O	U	L	E	S	U	K	R	Z	A	E	A
I	M	O	L	M	T	J	A	C	E	G	O	V
O	T	S	F	A	L	C	M	J	A	F	R	E
N	A	B	S	J	M	O	I	S	T	U	R	E
Z	E	M	G	F	A	V	A	P	O	R	F	M

WORD SEARCH ANSWER KEY

C	E	G	M	K	B	L	D	M	O	H	R	R
O	R	T	O	U	J	C	L	O	U	D	I	K
N	E	K	L	Z	W	B	C	M	D	Y	A	E
D	R	A	E	I	R	Z	I	I	B	Z	D	T
E	E	K	C	G	E	D	L	R	O	E	B	A
N	H	M	U	P	F	O	M	K	T	M	K	R
S	P	I	L	E	S	P	Z	A	E	O	E	O
A	S	O	E	C	U	L	R	E	A	T	E	P
T	O	U	L	E	S	U	K	R	Z	A	E	A
I	M	O	L	M	T	J	A	C	E	G	O	V
O	T	S	F	A	L	C	M	J	A	F	R	E
N	A	B	S	J	M	O	I	S	T	U	R	E
Z	E	M	G	F	A	V	A	P	O	R	F	M

HOME WATER USE

6 - 8

SUBJECTS:
Ecology, Math

TIME:
20 minutes

MATERIALS:
plastic ruler
bath tub with shower
student sheet

OBJECTIVES

The student will do the following:

1. Calculate the volume of water used in the home.

2. Identify methods of conserving water in the home.

BACKGROUND INFORMATION

Which requires less water, a bath or a shower? Did you know 30 percent of your indoor water is used in flushing the toilet? The average toilet uses five to seven gallons per flush. An average household can save about $100 a year and help conserve thousands of gallons of water by installing water-efficient toilets. These "improved" toilets rely on an efficient bowl design and increased flushing velocity—instead of extra water—to remove wastes.

Which uses more water—washing dishes by hand or in a dishwasher? The average dishwasher uses about 10 gallons of water per load, while washing the same number of dishes by hand takes about 16 gallons (though you'll use less water if you use the sink or a dishpan for washing and rinsing). Newer, efficient dishwashers use as little as five gallons per cycle, which means they also consume less energy to heat the water.

Showers and baths account for one-third of most families' water use. The typical shower head allows a water flow of eight to 10 gallons per minute. Installing a flow restrictor or low-flow shower head will reduce this flow by one-half, and most people can't tell the difference. A faucet that drips once per second wastes 2,300 gallons of water a year. Most household leaks are easily fixed by replacing worn parts, like the washer.

Terms

natural resource: something (as a mineral, forest, or kind of animal) that is found in nature and is valuable to humans.

freshwater: water containing an insignificant amount of salts, such as in inland rivers and lakes.

renewable resource: a resource or substance, such as a forest, that can be replenished through natural or artificial means.

conserve: to save a natural resource, such as water, through intelligent management and use.

ADVANCE PREPARATION

A. Discuss with students the importance of conserving water.

B. Make sure each student has a plastic ruler.

PROCEDURE

I. Setting the stage

A. Ask students to estimate how many gallons of water they use daily.

B. Ask students to estimate how many gallons of water they use when taking a bath or shower.

II. Activities

A. Have students measure the amount of water they use when taking a bath by following these steps:

1. Run the bath.

2. Before getting into the tub, measure the depth of the water with a plastic ruler.

3. Record the depth of the water on the Student sheet.

B. Have students measure the amount of water they use when taking a shower by following these steps:

1. Close the bathtub drain.

2. Take a shower using your usual amount of time.

3. Before draining the bathtub, measure the depth of the water with a plastic ruler. (Do not stand in the tub when measuring.)

4. Record the depth of the water on the Student sheet.

III. Follow-Up

A. Have the students answer the following questions on Student Sheet 1.

1. Which requires more water, a bath or a shower?

2. Should the procedure have included a specific length of time for the shower?

3. Why is it important that the depth of the water in the tub be measured without a person in the tub?

B. Have the students review Home Water Use - Ways to Save Water: Student Sheet 2. Ask students to check each one they already use in their home to save water. Have them circle the ones they will plan to use in the future.

C. Have students answer the questions on the Home Water Student Sheet 3. Have them answer questionsl individually first. Then put them into small groups and have them compare answers.

IV. Extensions

A. Ask the students to imagine their city is experiencing a severe water shortage. Have them list ways in which they, as citizens, can conserve water during the crisis.

B. Ask students to keep track of how many baths and showers are taken in their home each day for a week. Calculate how much water is used in the house for baths and showers.

C. Have students go to a hardware store or call one and find out about shower flow restricters. How do they work? How much water do they save? Calculate how much water could be saved in their house if one was installed in each shower.

D. Call the city or county water department. Find out where the city water comes from and how much it costs per 1,000 gallons.

RESOURCE

Earth Science. Prentice Hall, Englewood Cliffs, NJ, 1991.

Directions: Measure the length and width of the bathtub or shower. Then measure the depth of the water used for a bath and for a shower. Record these measurements below:

Bath:

Shower:

To determine how much water is used in one bath or shower, use the formula for volume, V = length x width x height. Use your measurements from above.

Bath:

Shower:

Using the chart below, figure the amount of water used in one day, one week, one month, and one year, by multiplying the volume of water used in one bath or shower by the number of baths and showers taken during each of those times.

	1 Day	1 Week	1 Month	1 Year
Bath Tub				
Shower				

Now, answer the following questions:

1. Which requires more water, a bath or a shower?

2. Should the procedure have included a specific length of time for the shower?

3. Why is it important that the depth of the water in the tub be measured without a person in the tub?

Ways to Save Water

1. Never put water down the drain when there may be another use for it, such as watering a plant or garden or cleaning.
2. Verify that your home is leak-free because many homes have hidden water leaks. Read your water meter before and after a two-hour period when no water is being used. If the meter does not read exactly the same, there is a leak.
3. Repair dripping faucets by replacing washers. If a faucet is dripping at the rate of one drop per second, 2,700 gallons per year can be wasted, which adds to the cost of water and sewer utilities and places strain on septic systems.
4. Check for toilet tank leaks by adding food coloring to the tank. If the toilet is leaking, color will appear within 30 minutes.
5. Avoid flushing the toilet unnecessarily. Dispose of tissues, insects, and other waste in the trash rather than the toilet.
6. Take shorter showers. Replace shower heads with ultra-low-flow versions.
7. Use the minimum amount of water needed for a bath by closing the drain first and filling the tub only 1/3 full.
8. Operate automatic dishwashers and clothes washers only when they are fully loaded, or properly set the water level for the size of load being washed.
9. When washing dishes by hand, fill one sink or basin with soapy water. Quickly rinse them under a slow-moving stream from the faucet.
10. Store drinking water in the refrigerator rather than letting the tap run every time cold water is needed.
11. Do not use running water to thaw meat or other frozen foods. Defrost food overnight in a refrigerator or by using the defrost setting on a microwave.
12. Kitchen sink disposals require lots of water to operate properly. Start a compost pile as an alternate method of disposing food waste instead of using a garbage disposal. Garbage disposals also can add 50% to the volume of solids in a septic tank which can lead to malfunctions and maintenance problems.
13. Insulate water pipes. Hot water is available faster, and this avoids wasting water while it heats up.
14. Don't over water the lawn. As a general rule, lawns only need watering of one inch every 5 to 7 days in the summer. A hearty rain eliminates the need for watering for as long as two weeks.
15. Water lawns during the early morning hours when temperatures and wind speed are the lowest. This reduces losses from evaporation.
16. Don't water the street, driveway, or sidewalk. Position sprinklers so that water lands on the lawn and shrubs — not the paved areas.
17. Raise the lawn mower blade to at least three inches. A lawn cut higher encourages grass roots to grow deeper, shades the root system, and holds soil moisture better than a closely clipped lawn.
18. Avoid over-fertilizing the lawn. The application of fertilizers increases the need for water.
19. Plant native and/or drought-tolerant grasses, ground covers, shrubs and trees. Once established, they do not need to be watered as frequently, and they usually will survive a dry period without any watering.
20. Do not hose down the driveway or sidewalk. Use a broom to clean leaves and other debris from these areas. Using a hose to clean a driveway can waste hundreds of gallons of water.
21. Consider using a commercial car wash that recycles water. At home, park the car on the grass when washing it.
22. Avoid the installation of ornamental water features (such as fountains) unless the water is recycled.
23. Consider a new water-saving pool filter for swimming pools. A single back-flushing with a traditional filter uses from 180 to 250 gallons or more of water.

STUDENT SHEET 3 HOME WATER USE

6 - 8

Directions: Answer the following questions in complete sentences.

1. How many gallons of water can you expect per year if a faucet drips at the rate of one drop per second?

2. How can you verify that your home is leak free?

3. Please explain how you can check for toilet leaks.

4. Why should you avoid over-fertilizing your lawn?

5. Why should you use a commercial car wash instead of washing your car by hand?

6. Is it possible to have an ornamental water feature (such as a fountain) and not waste water? Please explain.

7. Please list two reasons you should not use a garbage disposal.

8. What time of day should you water your lawn?

9. How can insulating your water pipes help to conserve water?

10. How does raising the blade on your lawn mower help to conserve water?

WATER METER READER

6 - 8

SUBJECTS:
Ecology, Math

TIME:
2 class periods
7 days to read home meters

MATERIALS:
home water meter
old water bill
student sheets

OBJECTIVES

The student will do the following:

1. Determine how much water his or her family uses at home.

2. Observe, interpret data, infer, and use numbers to compare water usage to that of other students.

3. Construct a graph using collected data on water usage.

BACKGROUND INFORMATION

Water is a valuable resource. The average household uses 200 gallons of water per day. Water shortages are occurring in many parts of the world because of rising demand from growing populations, unequal distribution of useable freshwater, and pollution. We must all be conscious of the water we are using and learn ways to conserve water. By changing personal habits, such as running water while brushing teeth, people can save a lot of water.

Each household can monitor the amount of water it uses by reading its water meter. There are several types of water meters. The water company in your area should have directions on how to read a water meter. Families can use meter readings as a challenge to reduce water use. Read the meter, obtain an average water use, and strive as a family to reduce water use by 1-2 gallons per day or 10-20 gallons per week, etc.

As much as half of the water being used now for domestic purposes can be saved by practicing certain conservation techniques. Water can be saved in the bathroom by using low volume shower heads, taking shorter showers, stopping leaks, and by using low volume or waterless toilets. Toilet flushing is the largest domestic water use. Each person uses 13,000 gal (50,000 liters) of drinking quality water a year to flush toilets. Regulations in many areas now require water-saving toilets be used. An old toilet can conserve water by having a water-displacement device, such as a half-gallon milk jug filled with water or sand, placed in the storage tank. Special water conserving appliances such as dishwashers and washing machines are available now that reduce water consumption greatly.

Approximate volumes of home water usage are as follows:

Bath	100–150 L (30-40 gallons)
Shower	20 L (5 gallons) per minute
Washing clothes	75–100 L (20-30 gallons)
Flushing a toilet	10-15 L (3-4 gallons) or more
Dishwasher	50 L (15 gallons) per load
Cooking	30 L (8 gallons) per day
Watering a lawn	40 L (10 gallons) per minute

Different communities use several types of water meters. Meters have different numbers of dials. As water moves through the water pipes, the meter pointers rotate. To read a meter, find the dial that has the lowest denomination indicated. Record the last number that the pointer has passed. Continue this process. If the meter has more than one dial, the meter may be measured in gallons, cubic feet, or cubic meters.

<u>Terms</u>

cubic feet: the volume of a cube whose edges are a specified number of feet in length. (Example: 3 cubic feet would be a cube that is 3 feet long, 3 feet high, and 3 feet wide.)

cubic meters: the volume of a cube whose edges are a specified number of meters in length. (Example: 3 cubic meters would be a cube that is 3 meters long, 3 meters high, and 3 meters wide.)

gallon: a unit of liquid capacity equal to four quarts (about 3.8 liters).

unit: a fixed quantity (as of length, time, or value) used as a standard of measurement; a single thing, person, or group forming part of a whole.

ADVANCE PREPARATION

A. Have students draw a picture of their water meter and bring it to class.

B. Have students bring to class a water bill from their households..

PROCEDURE

I. Setting the stage

A. Discuss the different types of meters using the pictures the students bring to class. Discuss the bills that the family receives each month.

B. Show students how to calculate how much water is used in a home using the Meter Reader Student Sheet.

C. Fill in Day 1 together as a class so students know how to use the sheet.

II. Activity

A. Have the students read their home water meters at the same time of the day for 7 days (one week).

B. Have the students subtract the previous day's reading to find the amount of water used each day.

C. Ask the students to record how water is used in their homes each day (bath, shower, clothes washing, dishwasher).

D. Using graph paper, have student plot data daily. Label the vertical axis with the units used by your meter.

III. Follow-Up

A. Have the students answer the following questions:

1. What day did your family use more water? Why?

2. What was the total amount of water used by your family during the week?

3. What is the average amount of water used by each person in your family?

4. Estimate a monthly and yearly average of water usage in your home.

5. Would the family's water usage vary during the year? Why?

6. How can your family conserve water?

IV. Extensions

A. Have students find out the source of their water supply and trace it until it reaches their homes. Who determines if the supply is pure? How often is the water tested, and how is the wastewater treated?

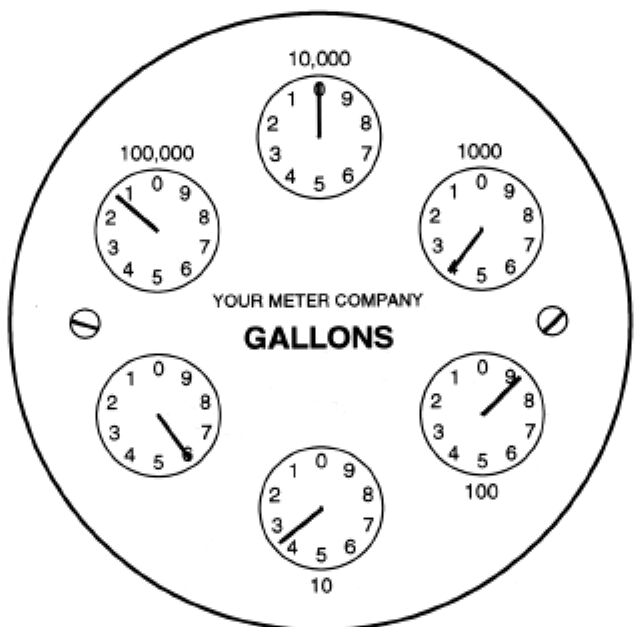
B. Have students visit home improvement shops to calculate the cost of water conserving products as well as to determine where to obtain them.

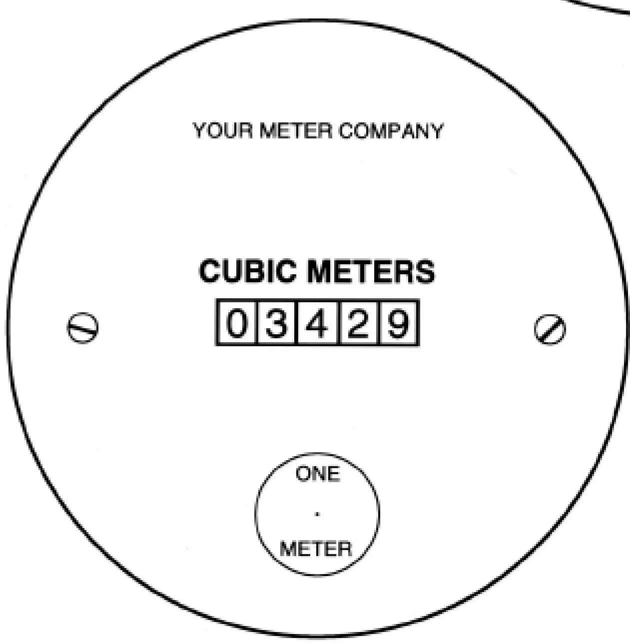
C. Take a field trip to a water treatment plant.

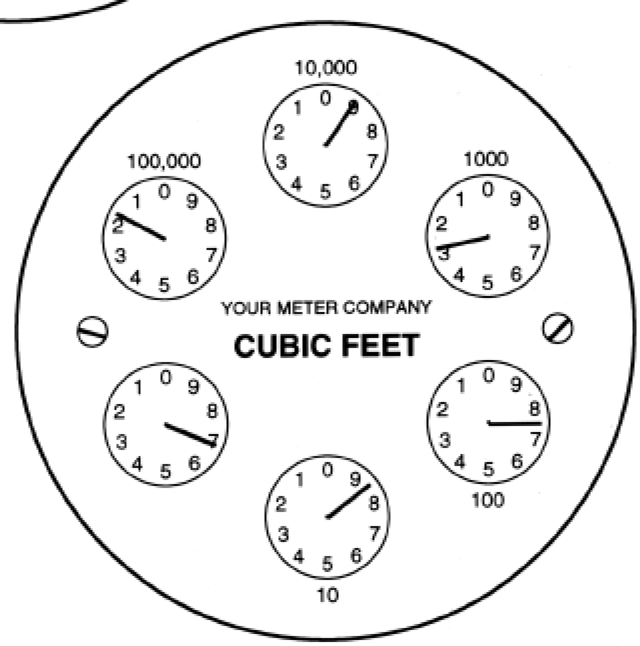
RESOURCES

Cunningham, William P. and Barbara Woodsworth Saigo, Environmental Science: A Global Concern, Wm. C. Brown Publishers, Dubuque, Iowa, 1995.

YOUR WATER METER PROBABLY LOOKS LIKE ONE OF THESE. THE FIRST METER IS READ CLOCKWISE AND MEASURES WATER IN GALLONS. THE SECOND METER MEASURES WATER IN CUBIC FEET AND IS READ IN THE SAME MANNER. (TO CONVERT CUBIC FEET TO GALLONS YOU MUST MULTIPLY THE NUMBER ON THE METER BY 7.5.) THE THIRD METER IS READ LIKE A DIGITAL CLOCK. METERS 1 AND 2 HAVE SIX DIALS, WHICH ARE READ CLOCKWISE. BEGIN WITH THE “100,000” DIAL AND READ EACH DIAL TO THE “1” DIAL. REMEMBER THAT WHEN THE DIAL IS BETWEEN TWO NUMBERS, YOU READ THE SMALLER NUMBER. READ AND RECORD THE NUMBER SHOWN ON EACH METER.







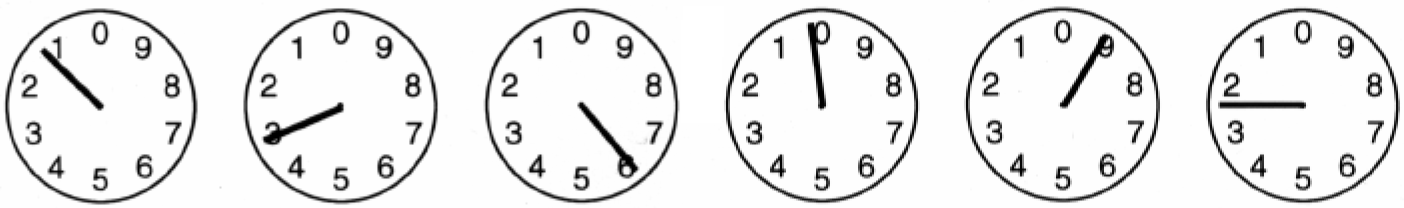
STUDENT SHEET

WATER METER READER

6-8

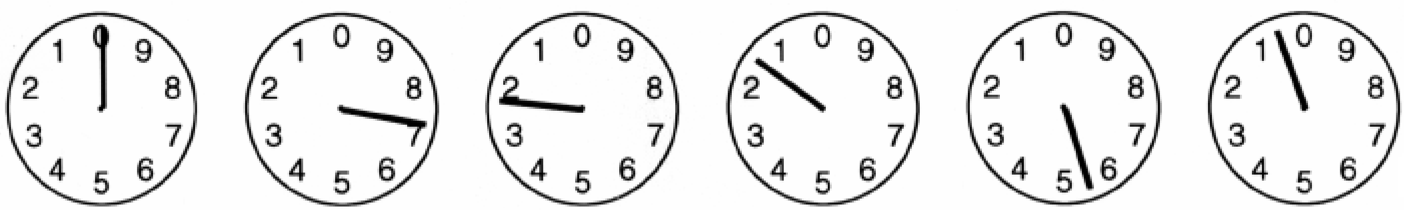
DIRECTIONS: READ THE DIALS FROM LEFT TO RIGHT. WHEN THE DIAL IS BETWEEN TWO NUMBERS, READ THE SMALLER NUMBER. WRITE THE NUMBERS IN THE BLANKS BELOW THE DIALS.

1.



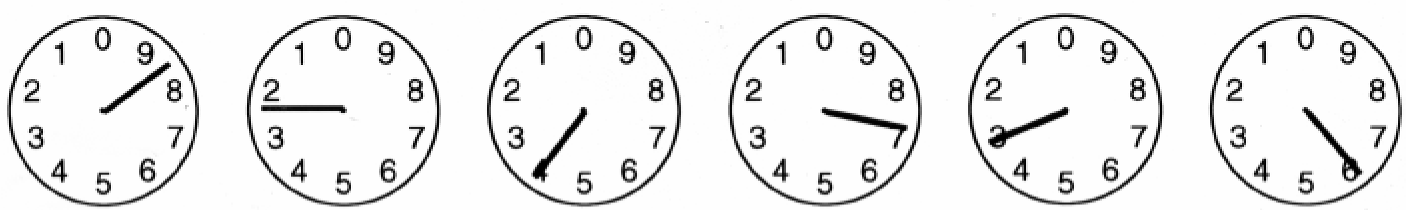
______ ______ ______ ______ ______ ______

2.



______ ______ ______ ______ ______ ______

3.



______ ______ ______ ______ ______ ______

STUDENT SHEET — WATER METER READER

6 - 8

Directions: List how water is used in your home. Indicate how many times each occurred and how much water was used. Compute a total for each day and for the entire seven days.

Day 1 — Date ____________

shower (25 gal)	x ______	showers	= ______	gallons
bath (35 gal)	x ______	baths	= ______	gallons
dishwasher (15 gal)	x ______	loads	= ______	gallons
laundry (20 gal)	x ______	loads	= ______	gallons
toilet (4 gal)	x ______	flushes	= ______	gallons
teeth (1 gal water runs)	x ______	brushings	= ______	gallons
meals (8 gal per day)			= 8	gallons
		Total Gallons	______	

Day 2 — Date ____________

shower (25 gal)	x ______	showers	= ______	gallons
bath (35 gal)	x ______	baths	= ______	gallons
dishwasher (15 gal)	x ______	loads	= ______	gallons
laundry (20 gal)	x ______	loads	= ______	gallons
toilet (4 gal)	x ______	flushes	= ______	gallons
teeth (1 gal water runs)	x ______	brushings	= ______	gallons
meals (8 gal per day)			= 8	gallons
		Total Gallons	______	

Day 3 — Date ____________

shower (25 gal)	x ______	showers	= ______	gallons
bath (35 gal)	x ______	baths	= ______	gallons
dishwasher (15 gal)	x ______	loads	= ______	gallons
laundry (20 gal)	x ______	loads	= ______	gallons
toilet (4 gal)	x ______	flushes	= ______	gallons
teeth (1 gal water runs)	x ______	brushings	= ______	gallons
meals (8 gal per day)			= 8	gallons
		Total Gallons	______	

Day 4 — Date ____________

shower (25 gal)	x ______	showers	= ______	gallons
bath (35 gal)	x ______	baths	= ______	gallons
dishwasher (15 gal)	x ______	loads	= ______	gallons
laundry (20 gal)	x ______	loads	= ______	gallons
toilet (4 gal)	x ______	flushes	= ______	gallons
teeth (1 gal water runs)	x ______	brushings	= ______	gallons
meals (8 gal per day)			= 8	gallons
		Total Gallons	______	

Day 5 — Date ____________

shower (25 gal)	x ______	showers	= ______	gallons
bath (35 gal)	x ______	baths	= ______	gallons
dishwasher (15 gal)	x ______	loads	= ______	gallons
laundry (20 gal)	x ______	loads	= ______	gallons
toilet (4 gal)	x ______	flushes	= ______	gallons
teeth (1 gal water runs)	x ______	brushings	= ______	gallons
meals (8 gal per day)			= 8	gallons
		Total Gallons	______	

Day 6 — Date __________________

shower (25 gal)	x ________	showers	= ___________	gallons
bath (35 gal)	x ________	baths	=___________	gallons
dishwasher (15 gal)	x ________	loads	=___________	gallons
laundry (20 gal)	x ________	loads	=___________	gallons
toilet (4 gal)	x ________	flushes	=___________	gallons
teeth (1 gal water runs)	x ________	brushings	=___________	gallons
meals (8 gal per day)			= 8	gallons
		Total Gallons	___________	

Day 7 — Date __________________

shower (25 gal)	x ________	showers	= ___________	gallons
bath (35 gal)	x ________	baths	=___________	gallons
dishwasher (15 gal)	x ________	loads	=___________	gallons
laundry (20 gal)	x ________	loads	=___________	gallons
toilet (4 gal)	x ________	flushes	=___________	gallons
teeth (1 gal water runs)	x ________	brushings	=___________	gallons
meals (8 gal per day)			= 8	gallons
		Total Gallons	___________	