Water, Water Everywhere

Student Activity

Method:

Students observe a brief demonstration on the distribution of the world's water and then calculate how much water they use on a daily basis, both directly and indirectly.

Introduction:

Although 75 percent of the Earth's surface is covered with water, only a very small fraction is available for human use. Of the water that is available to us, some becomes contaminated from human actions, such as toxic run-off from agriculture, factories, or pollutants that we dump in the water supply from our sinks at home. Population growth over the past 30 years has caused demand for water to double in about half the countries in the world. Residents of states with rapidly growing populations, as well as citizens of other countries, often experience water shortages. In the following activity, students will gain an appreciation for the ways we use water and the need to conserve it.

Procedure: Part One

Set up:

1. Gather all materials.
2. Fill one of the larger containers with one liter (1000 ml) of water and add four drops of blue food coloring. This represents the total amount of water in the world and is what you'll be dividing into the other containers.
3. Fill one small container with sand and label it "deep groundwater."
4. Label the other large container "oceans" and the remaining three small containers "polar ice," "other," and "fresh water."
5. Make a transparency or PowerPoint slide of the diagram below.
6. Measure and set aside 34 grams of salt.

Activity:

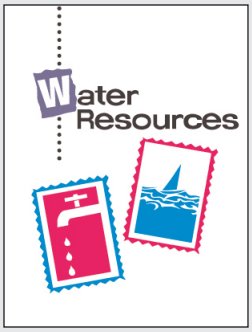
Perform the following class demonstration to help students visualize the distribution of the Earth's water resources:

1. Display the six containers prepared for this activity.
2. Display a transparency or slide of the figure on below. Explain to the class that the one liter of water represents all of the water in the world.
3. Use the graduated cylinder to distribute the one liter of water into the five containers as follows:

Distribution of the World's Water Supply	
Oceans	97.1%
Polar Ice	2.2%
Other (saltwater lakes, soiland atmospheric moisture, glaciers)	.1%
Deep Groundwater	.3%
Fresh Water	.3%

a) Pour 971 ml into the large "oceans" container. Then add the salt, explaining that the salinity of the Earth's oceans is 3.5 percent. Adding 34 grams of salt to the 971 ml of water will match the salinity ratio of the water sample with the salinity of the oceans.

b) Pour 22 ml into the "polar ice" container. Place this container in the freezer, if convenient.



Concept:

Although water covers three-quarters of the Earth, only a small fraction is available for human consumption. As the population grows, water efficiency and conservation become more important.

Objectives:

Students will be able to:

- Understand aspects of a shared natural resource, such as availability and distribution.
- Estimate the amount of resources they use and compare that figure to actual use.
- Design a graph to show current resource use and use after conservation measures have been taken.

Subjects:

Biology, environmental science, mathematics, family and consumer sciences

Skills:

Estimation, graphing, mathematic calculation, observation, research, writing

Materials:

6 clear containers (2 larger containers; 4 smaller containers – plastic is best)
1000 ml graduated cylinder
Overhead projector
1 liter of water
Salt (34 grams)
Sand (approximately 250 ml)
Blue food coloring
One eye dropper
Plate
Graph paper
Calculators (optional)
Copies of Student Worksheet and tables of water use
Freezer

c) Pour 3 ml into the "deep groundwater" container with the sand.

d) Pour 1 ml into the "other" container. Explain that this is water we don't have access to, and it is found in clouds, saltwater lakes, etc.

e) Pour the remaining 3 ml into the "fresh water" container.

4. Ask the students which of the containers represents fresh water that is readily available for human use. (They should easily see that only the jar marked "fresh water" has the readily available supply. The deep groundwater is also fresh, but it is not readily available.) Initiate a discussion on the limits of fresh water supplies, the problems of population growth and distribution, and the contamination of existing supplies. Ask students to brainstorm ways to ensure that our supply of water will be sufficient to meet the needs of our growing population.

Only a small part of this fresh water (.3 percent of the Earth's total water supply) is accessible. The rest is too remote (found in Amazon or Siberian rivers) to locate, too expensive to retrieve, or too polluted to use. Hold a plate in front of the class and dramatically drop the usable portion of fresh water onto it. (Represent this portion as one drop of water from an eye dropper.)

Adapted by permission from the National Science Foundation. The original activity appeared in the National Science and Technology Week Activity Guide, 1988 by the National Science Foundation, Washington, D.C.

Part Two:

1. Have students record how many gallons of water they think they use individually in an average day. Later, they will compare this estimated daily water use with their calculated daily water use.

2. As a group, have them list all the ways members of their class use water on a day-to-day basis.

3. Using the data in the table, "Domestic Uses of Water," have them determine their individual water use per day for each activity that the class listed in step two. They should include their share of general family uses such as washing dishes and clothes. Then they can determine their individual total water use per day.

4. Students should compare the individual water use calculated in step three with the water use estimated in step one. Are their calculated figures higher or lower than their estimated figures? Ask students whether they consider themselves typical water users. Have them explain their answers.

5. Students should now draw a bar graph to illustrate how much water is used by their class for each activity. Which activities require the most water? Using the class average, students can also calculate the total use of their town and/or state. (Avg. gallons used per person times number of people.)

Suggested Answers to Student Worksheet Questions:

1. Water is needed to grow the food and grasses the calf would consume.

2. Student answers will vary.

3. Student answers will vary.

4. Possible answers: purchasing and eating foods which require less water to cultivate (eating lower on the food chain); recycling items to prevent excessive use of water in manufacturing; driving less.

5. Possible answers: take showers instead of baths; don't let water run while brushing teeth or shaving; fix leaky faucets; install water-saving devices for toilet and shower; water lawn less frequently; run dishwasher and washing machine only when you have full loads.

6. Student answers will vary. For further information on water contamination, you may wish to contact the U.S. Environmental Protection Agency, www.epa.gov.

Follow-up Activities:

1. Have students investigate new household products that conserve water (such as low-flush toilets, new shower heads, timed sprinklers, etc.). Each student or group of students could be responsible for writing up a brief synopsis of the costs and benefits of one or two of these products.

2. Have students read their home water meters daily for a week, at the same time each day, and report back to the class. They can then compare these readings to their estimates of daily water use. Then they can read the meter for a second week, in which they implement many of the conservation measures suggested above.

Assessment Ideas:

Use the student worksheet to assess the accuracy of the student's calculations and the thoughtfulness of conservation ideas.

Adapted by permission from Biological Science Curriculum Study. The original activity appears in Biological Science: An Ecological Approach (Kendall-Hunt Publishing Company, 1987, 1992, 1998, 2002, 2006).

DOMESTIC USES OF WATER

Activity	Gallons Used
Low-flow faucet	1.5/minute
Standard faucet	5/minute
Ultra-low-flow toilet	1.3/flush
Standard toilet	4/flush
Low-flow showerhead	2/minute
Standard showerhead	5/minute
Tub bathing	40
Cooking a meal	5-7
Washing dishes by hand	30 (8-10/meal)
Automatic dishwasher	10
Front-loading washing machine	4/load
Top-loading washing machine	15/load
Watering lawn	60-70
Faucet or toilet leak	9/day

INDIRECT USES OF WATER

Agricultural

Item	Gallons Used
1 lb. grain-fed beef	5,214
1 lb. cotton	2,000
1 lb rice	560
1 dozen eggs	544
1 lb. corn	170
1 loaf of bread	150
1 lb. apples	48
1 lb. potatoes	24

Industrial

Item	Gallons Used
1 gallon gasoline	10
1 lb. steel	25
1 kw electricity	80
1 lb. paper	100
1 lb. synthetic rubber	300
1 lb. aluminum	1,000
1 car	100,000

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Student Worksheet

1. There are many water uses that are not obvious to most people. Consider, for example, that 1.2 million gallons of water are needed to raise one calf until it is fully grown. Why do you think so much water is needed to raise a calf?

2. Make a list of the ways you use water indirectly, for example, in the production of food you eat or materials you use.

3. Compare your list with the table above, "Indirect Uses of Water." How many of these uses did you list?

4. How could you reduce your indirect use of water?

5. What could you do to reduce your direct use of water?

6. Is there any evidence that the water supply you use daily is decreasing in size or is being contaminated by pollutants? How could you go about obtaining this information?