A SALT WATER-Y WORLD

OBJECTIVES

The student will do the following:

1. Observe a model of the distribution of the earth's water.

2. Compare the relative volumes and percentages of types of water on earth.

3. Demonstrate solar distillation.

SUBJECTS:
Science, Social Studies, Math

TIME:
50 minutes

MATERIALS:
two 1,000-mL graduated cylinders (or 1-L clear containers)
four 100-mL graduated cylinders (or small jars)
medicine dropper
food coloring
teacher sheet (included)
acetate sheet
overhead projector
large bowl or pan (1 per group)
small drinking glass (1 per group)
small rocks
plastic wrap
2-gallon bucket
water
soil
student sheet (included)

BACKGROUND INFORMATION

Humans must have fresh water to live, but about 97 percent of the earth's water is too salty to use. The remaining 3 percent is fresh water, but most of it is in polar icecaps, remote glaciers, and icebergs and is not easily accessible. Accessible fresh water, therefore, comes from surface water and groundwater sources. These sources represent less than one-half of one percent of all water on the earth.

Terms

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.

surface water: precipitation that does not soak into the ground or return to the atmosphere by evaporation or transpiration, and is stored in streams, lakes, wetlands, reservoirs, and oceans.

ADVANCE PREPARATION

A. If you do not have two 1,000-mL graduated cylinders, use other clear liter containers. If you have access to laboratory glassware, fifteen 100-mL graduated cylinders will work. If you use the small cylinders, ten of them will hold 972 mL of salt water, while the remaining five will hold fresh water. A clear plastic jug (soft drink container) holding one liter of colored water can be used. Other clear glasses or jars can hold the smaller divisions. The following table shows the distribution of water for this demonstration.

Earth's Total Water Supply	Earth's Total Fresh Water Supply
972 mL Ocean (salt water)	23 mL Icecaps and glaciers
28 mL Fresh water	4 mL Groundwater
1,000 mL Total Water on Earth	2* drops Surface water
	1* drop Water in air and soil
	28 mL Total Fresh Water on Earth

1 liter = 1,000 mL
*3 drops = 1 mL

B. Make a transparency from the teacher sheet "Water Distribution on Earth." (NOTE: You can make a chart rather than using a transparency and overhead projector.)

C. Duplicate copies of the student sheet.

D. Get a liter of water in the cylinder or bottle. Put food coloring in it so the students can see it.

E. Gather the materials to have 5-6 groups each build a distillation apparatus. Make muddy water by filling a 2-gallon bucket with water and mixing in about 2 cups of soil.

PROCEDURE

I. Setting the stage

A. Share with the students the background information.

B. Display the transparency or chart, "Water Distribution on Earth." Discuss this briefly with the students. Tell them you are going to show them what these proportions look like.

II. Activity

A. Place all the materials on a table in front of the class.

1. Fill one graduated cylinder with colored water to the 1,000 mL line. Tell the students that this represents the earth's entire supply of water. Pour 28 mL of this water into a second 1,000-mL graduated cylinder. The 28 mL of water represents the earth's total fresh water supply. The remaining 972 mL of water is salt water that occurs primarily in oceans.

2. Divide the 28 mL of fresh water by pouring portions of it into smaller containers: 23 mL for icecaps and glaciers, 4 mL for groundwater, 2 drops for surface water, and 1 drop for the water in the atmosphere and soil.

3. Refer the students again to the table on surface water distribution.

B. As the students examine and compare the different volumes of water in the graduated cylinders, ask the following questions:

1. Which of the four fresh water graduated cylinders represents the most fresh water on earth? (23 mL, representing icecaps and glaciers)

2. Is this a source of fresh water commonly used by humans for drinking, watering the lawn, cleaning, and so on? Explain. (No, icecaps and glaciers are usually too far away from population centers.)

3. Approximately what percentage of the earth's fresh water is groundwater? (0.4%, or less than one-half of one percent)

4. Where is most of earth's water found? (oceans)

5. Can cities such as San Francisco, Miami, and New York City, which are near oceans, use the water from the oceans for households and industry? Explain. (No, the ocean water contains salts that are harmful to humans, plants, animals, and metals.)

6. Can the salts be removed from water? Why isn't this commonly done? (Yes, but the desalination process is very expensive.)

7. Why is the little bit of water in the atmosphere important to plants, animals, and humans? (Water in the atmosphere is carried inland in the forms of rain, snow, sleet, and hail which supply fresh water sources such as lakes, streams, and groundwater.)

C. Have the students do the demonstration of desalination using solar energy found on the student sheet "Sun Power for Clear Water." (Choose a sunny day.)

1. Divide them into groups of about 5 students each.

2. Give each group the materials. Explain that you will use muddy water instead of salty water so they can see that the distilled water is clean.

3. Take the class outside and let them set up their distillation devices.

4. Allow the students to play or do outdoor education activities for about 20-30 minutes, then begin checking the devices.

5. When clear water has dripped into the glasses, discuss with the students how heat from the sun cleaned the water.

III. Follow-Up

A. Ask the class the following questions:

1. Which kind of water (fresh or salt water) do we have more of on the earth? (salt)

2. Can people drink salt water right out of the ocean? (no)

3. Is there more water underground than in all the lakes and rivers of the world combined? (yes)

4. Can people make fresh water out of salt water? (yes)

B. Have the students draw a picture of the distillation device and write a few sentences describing how it worked.

IV. Extension

A. Have the students write the percentages of water distribution, as given on the teacher sheet. Can they express this in hundredths and thousandths?

B. Have the students think of several ways that salt water could be distilled to make drinkable fresh water. (You might divide them into groups.) Allow them to sketch distillation devices to provide families or communities with large amounts of water.

C. Have the students sing the following song to the tune of "My Bonnie Lies Over the Ocean":

Sing a Sea Song

The Earth is all covered with ocean.
The Earth is all covered with sea.
The Earth is all covered with ocean.
More water than land, don't you see?

Chorus
Water, water, there's water all over the world, the world.
Water, water, there's water all over the world, the world.

So salty and cold is the ocean.
So salty and cold is the sea.
So salty and cold is the ocean.
Too cold and too salty for me.

Repeat Chorus

Atlantic, Pacific, the Arctic,
And then there's the Indian too.
These oceans all over our planet.
I named all of them, now can you?

Repeat chorus

RESOURCES

The Energy Sourcebook: Elementary Unit, Tennessee Valley Authority, 1990.

"Sing A Sea Song," Ranger Rick's NatureScope: Diving Into Oceans, National Wildlife Federation, Washington, DC, p. 8., 1989.

Vandas, S., "Water: The Resource That Gets Used and Used and Used for Everything!" (poster). Available from American Water Resources Association , 5410 Grosvenor Lane, Suite 220, Bethesda, Maryland 20814-2192, 301-493-8600 or The National Science Teachers Association, 1742 Connecticut Avenue NW, Washington, DC 20009, 202-328-5800.

WATER DISTRIBUTION ON EARTH

Earth's Total Water Supply

97.2 %	Oceans (salt water)
2.8 %	Fresh water
100.0 %	**Total Water on Earth**

Earth's Total Fresh Water Supply

2.38 %	Icecaps, glaciers
0.39 %	Groundwater
0.029 %	Surface water (lakes, rivers, etc.)
0.001 %	Air and soil
2.8 %	**Total Fresh Water**

SUN POWER FOR CLEAN WATER

1. Put muddy water in a large bowl or pan to a depth of 2 inches (5 centimeters).

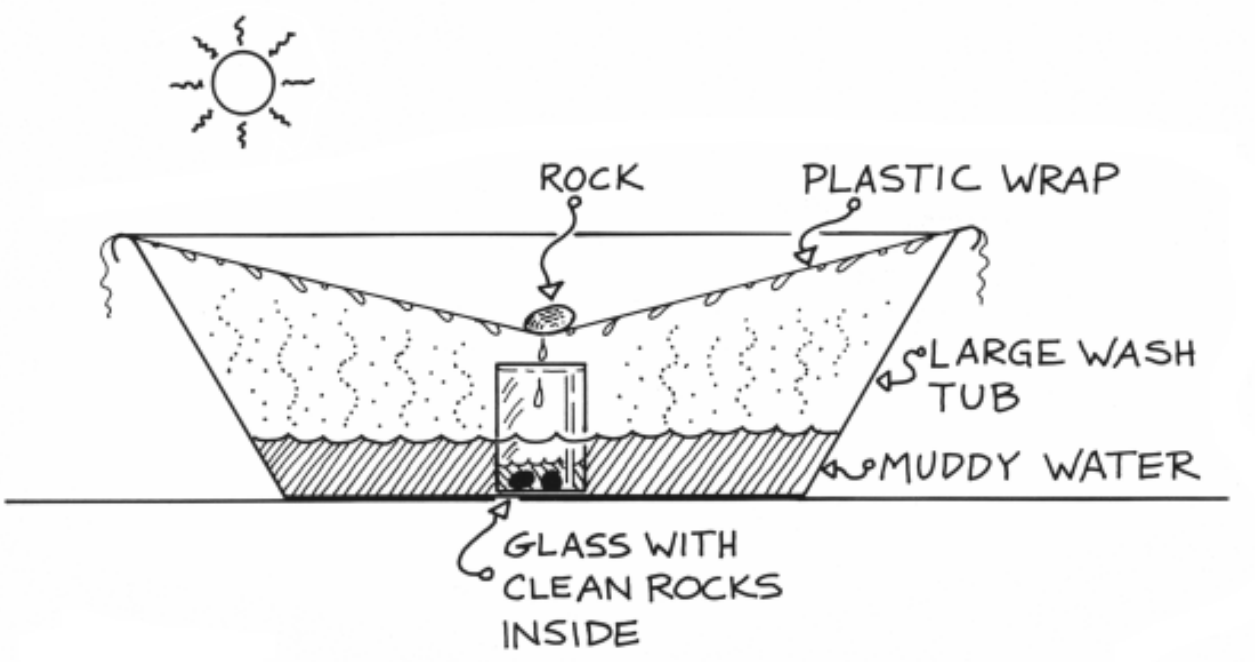
2. Set it in a place where it will receive sun all day.

3. Place a small glass right-side up in the middle of the tub. You may have to weight it down by putting two small, clean rocks in it.

4. Cover the tub tightly with clear plastic wrap.

5. Place a rock on the plastic over the center of the glass. Do not let the plastic touch the glass. (Just weight it down in the middle.)

6. Observe what happens. Record your observations. Propose a way that this procedure, called "distillation," might be helpful on a larger scale.



Observations

_____

_____

Questions

1. What kind of energy cleaned the water? _____

2. How might this process be useful to people? _____

WATERY WORDS AND PLACES

OBJECTIVES

The student will do the following:

1. Name several kinds of bodies of water on earth.
2. Locate the major bodies of surface water in your state.
3. Construct a relief map of his/her state using a physical map.

SUBJECTS:
Geography, Language Arts, Art

TIME:
3-30 minute periods

MATERIALS:
3' x 5' (1 m x 1.5 m) piece of blue paper
magic marker
salt dough (recipe included)
food coloring (blue, green, brown)
physical map of your state (2 copies per student or team)
individual-sized pizza box for each student or team
glue
crayons
pencils
wall map of your state
student sheet (included)
teacher sheet (included)

BACKGROUND INFORMATION

Most of the surface of our world is covered by water. Salt water bodies include bays, estuaries, fjords, gulfs, harbors, oceans, seas, sounds, and straits. Fresh water bodies include coves, creeks, inlets, lagoons, lakes, ponds, reservoirs, rivers, rivulets, streams, tributaries, and waterfalls.

Term

surface water: precipitation that does not soak into the ground or return to the atmosphere by evaporation or transpiration, and is stored in streams, lakes, wetlands, reservoirs, and oceans.

ADVANCE PREPARATION

A. Have the blue paper "pond" ready.

B. Make salt dough for the relief map:

1 cup (250 mL) plain flour
1/2 cup (125 mL) salt
2 tsp (10 mL) cream of tartar
1 cup (250 mL) water
1 tbs (15 mL) cooking oil
food coloring (green, brown, or blue)

Stir the dry ingredients together in a heavy saucepan. Add the liquids and cook 3 minutes at low temperature or until it pulls away from the sides of the pan. Knead slightly almost immediately and store in an airtight container. Determine how many batches of each color you need by your state's geography and the number of maps to be made.

C. Obtain individual-sized pizza boxes (one per student or team) from a local restaurant.

D. Get 2 or 3 parent volunteers or aides to help you with the map activity.

E. Obtain a physical map of your state. Make two copies of a physical map of your state for each student or team; reduce or enlarge them as necessary to make them fit the small pizza boxes.

F. Make a copy of the word search puzzle (included) for each student.

PROCEDURE

I. Setting the stage

A. Have the students complete this analogy.

generic : common nouns :: brand name : _____
(proper nouns)

B. Tell the students that in the following activity, they will be using common nouns.

C. Have the students brainstorm all the types of surface water they can think of. Write the appropriate words on the blue paper as they think of them.

II. Activities

A. Pass out the student page "Watery Words" (word search).

1. Have them find as many words as possible. (See the teacher key following the puzzle.)

2. Have the students select 5 words they are not familiar with. Look them up, and write the definitions on the back of their paper.

B. Have the students construct a relief map of your state. Use cooperative learning groups or, if you have enough supplies, let each student do his/her own map. (NOTE: You will need several adult helpers.)

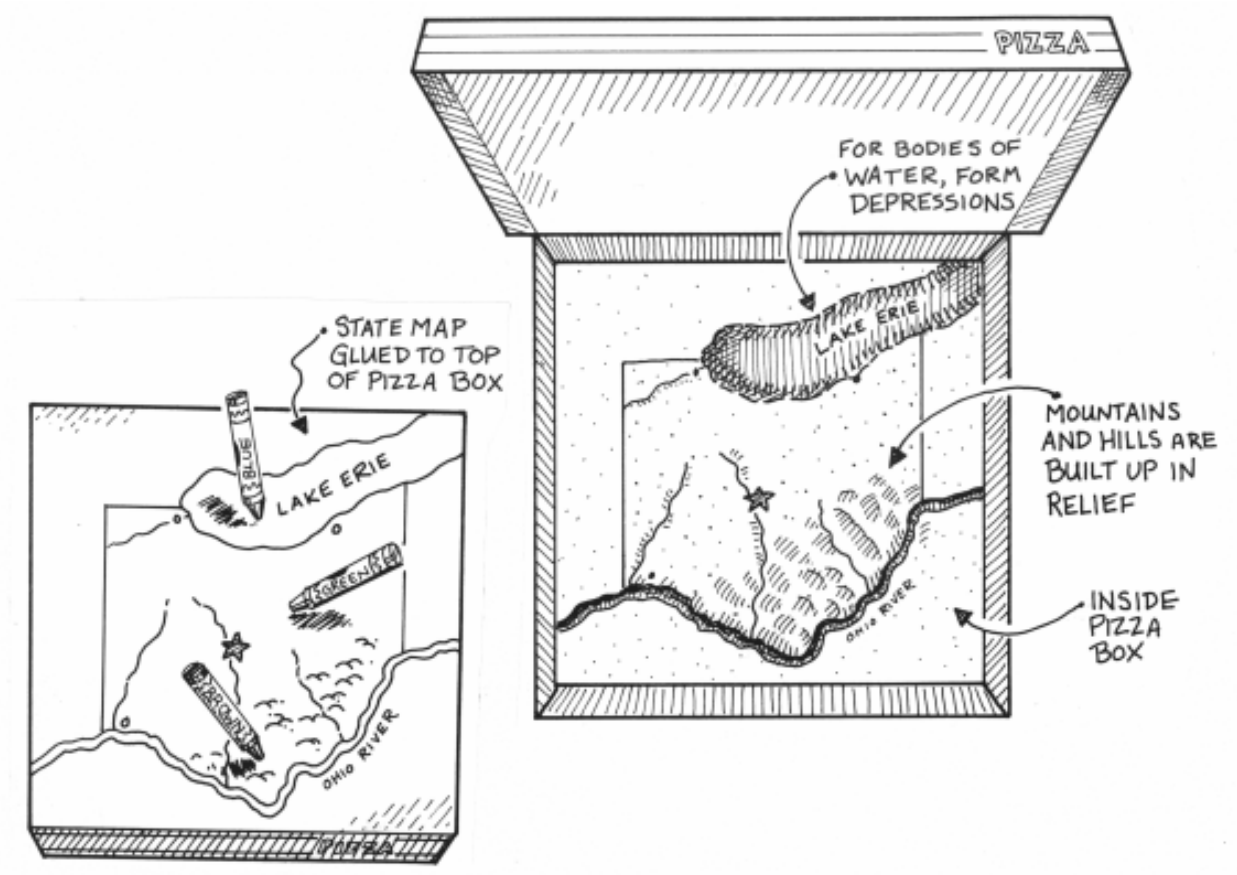
1. Have the students examine a wall map of your state. Discuss the most noticeable features of your state's geography.

2. Give the students two copies of the state's physical map and have them use blue, green, and brown crayons to color the maps. Have them make a legend and label the important bodies of water and cities.

3. Discuss the fact that many cities were originally located on rivers because of transportation and water source purposes.

4. Have the students glue this map to the top of the pizza box and glue the second map to the inside of the box.

5. Have them use the salt dough to build the relief map, starting with the green or brown dough to make the mountains, hills, and valleys. Tell them to do the blue bodies of water last. They will be in depressions. Let the maps dry.



III. Follow-up

A. Have the students redraw from memory a map of your state. Tell them to name the major bodies of water (choose appropriate requirements for you state and your students).

B. Have the students write sentences using 10 of the "watery words" correctly. (If you desire, you could modify this to require more words or to use a given number of them in a story.)

IV. Extensions

A. Have the students put the water words on your blue pond in alphabetical order.

B. Have the students look up different countries, cultures, and/or bodies of water around the world. What do they call their <u>boats</u>? (Examples: Hong Kong - sampan, junk; Alaska - kayak; Florida- hydrofoil; Navy - destroyer. What about ferry, tugboat, felucca, prau, scor, xebec, and dhow?)

C. Check the Macmillan 4th Grade Book, <u>Music and You</u> (pages 22-23) for the song "Little Blue Top." Teach it to the students.

D. Play the Alphabet Game: Form a circle with your class. Say, "I am going to start the alphabet game using <u>proper</u> nouns associated with water." Begin by saying, "A - Atlantic Ocean." The next person says "B -_____." (Rules: Students must say their letters then think of the word. This assures that they are working on the correct letter. You might want to give a time limit for thinking. If a student wants to pass, he/she may just say "pass." The next person must repeat the same

letter and think of a word. If everyone in the circle passes, then the game continues with the first person that passed taking the next letter in the alphabet. (It should continue like this: B- Bay of Fundy, C-Caribbean Sea, etc.) (This may be difficult for them, but you could let them play in teams, with each team using a globe or world map.) You may play it with other categories of water words.

E. Have the students complete more analogies.

swam : swim :: sailed : _____ (sail)

NaCl : salt :: _____ : water (H_2O)

source: beginning :: outflow : _____ (end)

river: line :: lake : _____ (circle)

F. Have the students list water words related to prepositional water phrases. Put the following on the chalkboard. Get students to think of words to put in each column.

With Water	On Water	In Water
~~shower (example)~~	~~ski (example)~~	~~swim (example)~~

G. Read At the Edge of the Pond by Dewey to students. Ask your students to think of as many verbs as they can to describe how pond animals move. (slither, dart, gyrate, leap, etc.)

H. Ask your students to think of as many adjectives as they can to describe water in this phrase: the _____ pond (smooth, glassy, ripply, wavy, scummy).

I. If you have an Electronic GeoSafari Geography Game, this is a great time to use it.

J. Ask the students what body(ies) of water could they swim in where they would float most easily? (Great Salt Lake, Dead Sea) Have the students investigate where they would find inland salt lakes or seas. Look for information on "why" they are salty. Locate them on a world map.

K. Read Paul Bunyan stories that pertain to water to your class (see Resources section).

RESOURCES

Dewey, Jennifer Owings, At the Edge of the Pond, Little, Brown & Co., Boston, Massachusetts, 1987.

Electronic GeoSafari Geography Game, Educational Insights, Dominquez Hills, California, 1989.

"Little Blue Top," Music and You, 4th Grade Book, Macmillan, New York, pp. 22-23.

Rounds, Glen, "The Whistling River," Ol' Paul the Mighty Logger, Cadmus Books, Wisconsin, 1949.

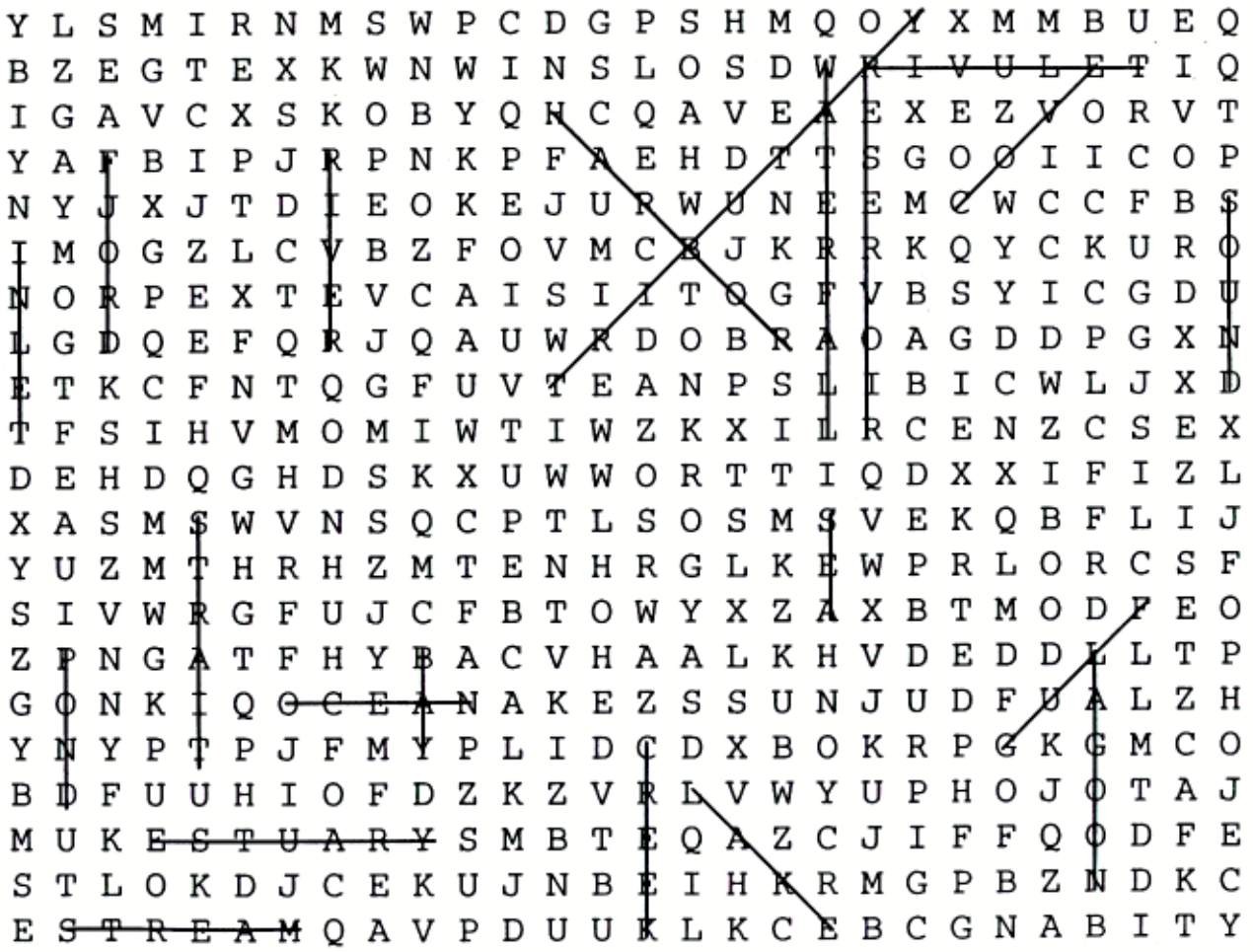
Schwartz, Linda, I Love Lists, Learning Works, Santa Barbara, California, 1988.

Shephard, Esther, "Digging Puget Sound," Paul Bunyan, Harcourt, Brace & Co., New York, 1952.

WATERY WORDS

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

WATERY WORDS ANSWER KEY



LIVING IN WATER

OBJECTIVES

The student will do the following:

1. Create a pond model.

2. Research and report about plants and animals found in aquatic habitats.

3. Contribute to a pond mural.

SUBJECTS:
Science, Writing, Art

TIME:
120 minutes

MATERIALS:
aquarium or plastic containers
gravel
sand
small fish
snails
water
buckets or other containers
aquatic plants
butcher paper
blue tempera paint
magic markers
index cards
glue sticks or transparent tape
reference materials (encyclopedias, etc.)
teacher sheets (included)
acetate sheet
overhead projector
sentence strips
scissors
magnetic tape or masking tape
shoe boxes (optional)
typing paper (optional)
box cutter (optional)

BACKGROUND INFORMATION

A body of water where organisms live is called an aquatic habitat. One type of aquatic habitat is the freshwater habitat. Ponds, lakes, and streams are freshwater habitats. Many kinds of plants are found in or near the water. Cattails may grow at the water's edge. The roots of water lilies anchor at the bottom, while their leaves and flowers float on top of the water. Other plants live under the water.

Aquatic animals need oxygen. A few aquatic animals breathe with lungs. Most aquatic animals have gills instead of lungs, to take the oxygen they need from the water. Many animals in the water move around to find food and to get away from predators. Other animals attach themselves to objects in the water and collect their food as it floats past. Some animals that live in or near fresh water are fish, such as bass and trout; birds, such as ducks and geese; insects, such as dragonflies and mosquitoes; amphibians, such as frogs and toads; and reptiles, such as turtles and snakes.

When aquatic biologists (scientists who study things that live in or on the water) study a lake or other body of fresh water, they look at characteristics of the habitat to assess its "health." These would include (1) the amount of dissolved oxygen in the water; (2) algal content (enough to provide food but not enough to become a burden itself); (3) the health of the fish; (4) the diversity of bottom-dwelling insect larvae, worms, shellfish, and other invertebrates (simple animals with no backbone); and (5) the amounts and types of pollution settled into the mud on the bottom of the lake. When factors such as these are in order, the lake is likely to be a healthy place for plants and animals.

Terms

aquatic: living or growing in or on the water.

organism: any living being; plants and animals.

habitat: place where an organism grows or lives.

ADVANCE PREPARATION

A. Gather materials for this activity. (NOTE: Fish, sand, gravel, aquatic plants, and snails may be collected locally or purchased at an aquarium supply store or biological science supply company.)

B. For the "Password" game, write the sentences, cut up the sentence strips, and put magnetic tape on the backs of the pieces.

C. Make a transparency of the teacher sheet, "Checking Out the Neighborhood."

PROCEDURE

I. Setting the stage

A. Tell the students to imagine they are aquatic organisms. Let them imagine that the classroom is a large fishbowl or pond. (If you wish, let them "swim" around briefly.)

B. Tell the class to "become land-dwelling creatures again," and ask them to name things they think aquatic creatures would need to be healthy.

II. Activities

A. There are at least five characteristics that indicate a healthy lake or other body of fresh water. List these on the board and briefly share with the students the information for each. You might call these "5 for Life," or "A Fish's Wishes."

1. Algae: Just the right amount of algae means there is enough plant material for a strong food chain, but not so much that oxygen supplies are used up by the decay organisms that multiply excessively if there is too much algae (too much algae means too much dead algae).

2. Oxygen: Water has oxygen dissolved in it. Oxygen levels in the water affect the size and number of fish, as well as other life in the lake. Without oxygen, almost all aquatic life is driven away or dies.

3. Fish: The condition of the fish living in the water tells a lot about the condition of the lake or pond. If the fish are healthy and there are a lot of different kinds and sizes, the lake is in good condition.

4. Bottom Life: The mud, sand, or gravel from a healthy lake bottom will include a large number and wide variety of worms, snails, crayfish, mussels, clams, and aquatic insect larvae.

5. Sediment: Samples of mud taken from the bottom of the lake are checked to see if it contains harmful chemicals from human activities (metals, PCBs, or pesticides). This is important because pollutants settle to the lake bottom where many fish and other small animals live.

Show the students a transparency of the teacher sheet "Checking Out the Neighborhood." Review with them what each illustrated item means.

B. Have the students make a pond model.

1. For a class pond, use an aquarium. For individual ponds, have students or teams of students use large, clear plastic containers, such as large peanut butter jars. As the students watch and/or participate, review the five habitat factors.

2. Place aquarium gravel, sand, or soil on the bottom of the containers.

3. Plant the water plants from a biological supply house or aquarium supply store (many large discount stores carry aquarium supplies).

4. Add dechlorinated water. (NOTE: You may dechlorinate tap water by letting it stand out overnight or using dechlorination tablets. The water must be dechlorinated or the animals you add may become ill or die.)

5. Complete the pond by adding tadpoles or small snails and small fish to the aquarium.

6. Maintain the classroom model pond as a classroom aquarium for the remainder of the school year. Make sure animals have clean water and enough food and air.

C. Have the students draw a diagram of the model.

III. Follow-Up

A. Have the class make a pond mural.

1. Use blue tempera paint (thin works fine) to paint a blue oval on a long piece of white butcher paper.

2. Assign pairs of students a pond plant or animal.

a. Possible plants and animals:

Plants - iris, reed, water lily, willow tree
Insects - dragonfly, damselfly, water beetle, pond skater, water scorpion
Reptiles - snake, turtle
Amphibians - frog, toad, newt, salamander
Mammals - beaver, otter, mink, raccoon
Fish - carp, sunfish, perch, bullhead, bass
Birds - red-winged blackbird, duck, swan, heron, hawk
Mollusks and crustaceans - snail, mussel, crayfish

b. Have students research their plant or animal and write one fact about it on an index card. (Ask the librarian to pull some appropriate references. Encyclopedias can also be used.)

c. Provide magic markers and direct each pair to draw its plant or animal on the mural and paste or tape the index card near it.

d. Let the class name their “pond.” Write the name on the mural and let each student sign it (like an artist).

3. Display the mural on a wall outside your classroom for everyone to learn from and admire.

B. Have the students play the “Password” game on the teacher sheet, “Aquatic Password.”

IV. Extensions

A. Have the students pretend they are pond plants or animals. Tell them to write sentences or a story describing their day without revealing what they are. Have them end their writing with the question, "What am I?" Then direct students to draw and label the mystery plant or animal on the back of their papers. Compile the papers into a class book titled, A Day at the Pond. The students will have fun as they "visit a pond" by reading each other's writings.

B. Have the students create water habitat models out of shoe boxes. (This is a good take-home activity.)

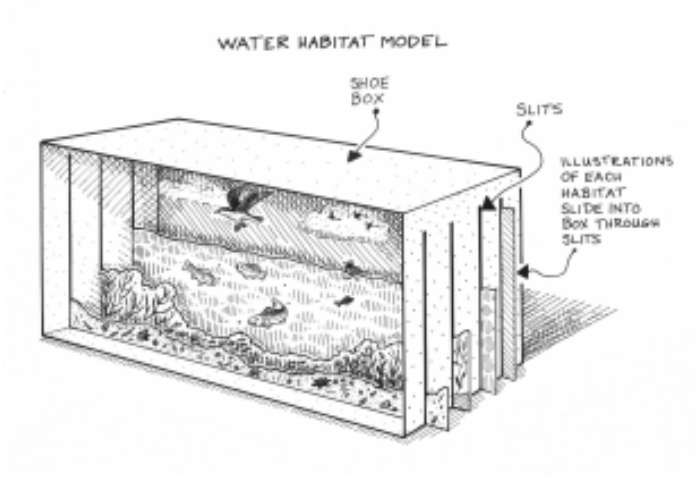
1. Cut slits on the sides of the box.

2. Use one sheet of typing paper for each aquatic habitat: bottom mud, plants anchored to the bottom, the water, and the air above the water.

3. Cut the paper to fit the slits. (The strips are progressively wider. See the figure.)

4. Have the students draw or illustrate each habitat on a separate strip of typing paper.

5. Slide the paper through the slits.



(NOTE: You might let some students make dioramas.)

RESOURCES

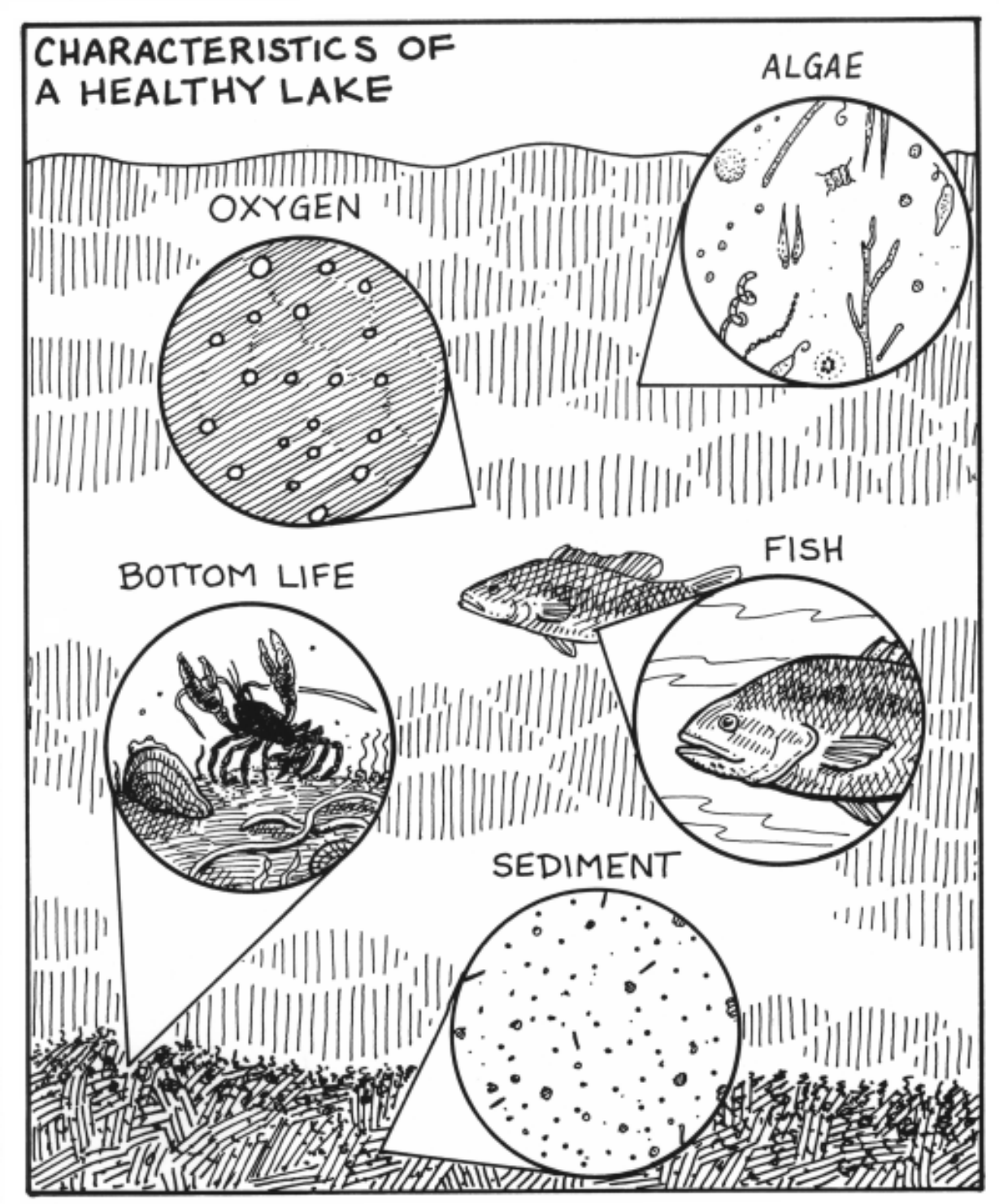
Hackett, J. K. and R. H. Moyer, Science In Your World, Macmilllan/McGraw-Hill School Division, New York, 1991.

Gay, K., Water Pollution, Franklin Watts, New York, 1990.

Frank Shaffer, "Pond Life," School Days, New York, 1992, pp. 34-57.

"What's Happening in Your Lake?," RiverPulse, Tennessee Valley Authority, Water Resource Division, July 1992.

CHECKING OUT THE NEIGHBORHOOD



AQUATIC PASSWORD

Rules

Divide the class into six or eight teams. Let two teams come to the chalkboard at the same time. Have both teams face the classroom. At a given time, the two teams are to turn to the board. Each will arrange the mixed-up sentence in front of it in the right order. Both teams will have the same sentence. The winner is the team that finishes first. Let the teams compete, then let the winning teams compete.

Preparation

Write the sentences on colorful sentence strips. (Make two versions of each one.) Cut them up (separating the words) and put magnetic tape on the back to enable them to stick to the board (masking tape can be used).

Use the following sentences:

1. Water lily is an aquatic plant.
2. Water beetles, dragonflies, and water scorpions are insects.
3. A turtle is a reptile.
4. Frogs, toads, and salamanders are amphibians.
5. Raccoons, minks, and beavers are mammals.
6. Bass, perch, and sunfish are fish found in ponds.
7. A hawk is a bird.
8. A cattail is a water plant.
9. An otter is a mammal.
10. A heron is a bird.
11. Algae are plants.
12. Some small animals live in the bottom mud.

POSTED! NO FISHING, NO SWIMMING

OBJECTIVES

The student will do the following:

1. Play a game to learn that it is not always safe to eat fish they catch.

2. Write a story about taking a trip to the beach and finding swimming prohibited.

3. Recognize that environmental laws protect their health.

SUBJECTS:
Science, Health, Language Arts, Physical Education

TIME:
60 minutes

MATERIALS:
construction paper
scissors
markers
masking tape
art paper
crayons
U.S. map

BACKGROUND INFORMATION

The first Federal law dealing exclusively with water quality was passed in 1948. It set aside government money for research. Offenders of the law only received a weak punishment. In 1969 the National Environmental Policy Act started all the environmental protection legislation. In 1972 the Clean Water Act was passed and in 1977 and 1987 more water quality regulations were added. The protection of human health is the most important goal of these laws.

Despite the passage of such laws, we still must deal with water quality issues. Some polluting happens now, but often we are faced with pollution that entered the environment years ago. This is the case with chemicals like DDT and PCBs; they do not break down in the environment and so tend to settle and collect in sediment on the bottom of bodies of water. They sometimes find their ways into food chains, ending up in fish that may end up on fishermen's lines. Waters are posted in such cases to prevent people from eating fish that might contain dangerous levels of chemicals.

Sometimes warning signs are posted around water bodies to prevent swimming because the water has been found to have unsafe levels of coliform bacteria from fecal contamination (human and animal waste). Coliforms are used as indicators for the presence of pathogens (disease-causing organisms). Fecal contamination represents on-going problems with waste management, not a long-ago problem, as the chemical pollution sometimes does.

Terms

DDT (dichlorodiphenyltrichloroethane): an insecticide that does not break down in the environment. Once widely used but now prohibited from most uses in the U.S.

dioxin: a toxic by-product of the manufacture of certain pesticides and other products.

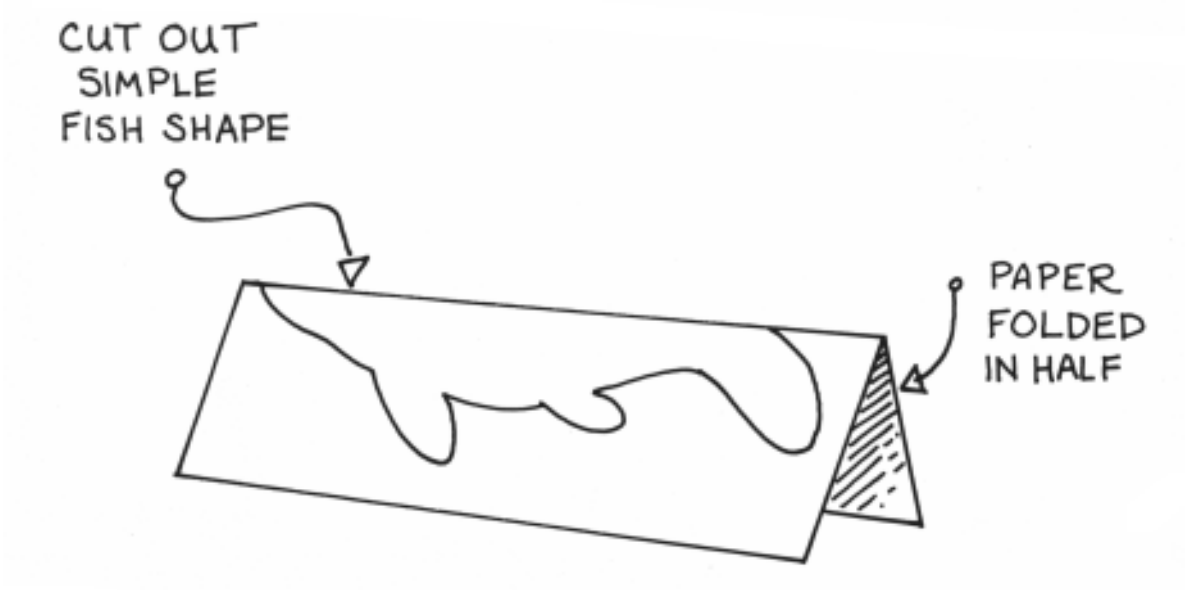
mercury: a poisonous metallic element, Hg, atomic number 80, atomic weight 200.59, existing at room temperature as a silvery, dense liquid.

PCBs (polychlorobiphenyls): industrial chemicals that do break down in the environment; once widely used in electrical transformers but now prohibited in the U.S.A.

pesticide: any chemical or biological agent that kills plant or animal pests; herbicides, insecticides, fungicides, rodenticides, etc., are all pesticides.

ADVANCE PREPARATION

Make a fish for each of two-thirds of your students. Fold a sheet of construction paper in half and cut out a simple fish shape, leaving it hinged on the fold. For half of them, open the fish, and write one of the messages below ("I ate . . .") inside.



PROCEDURE

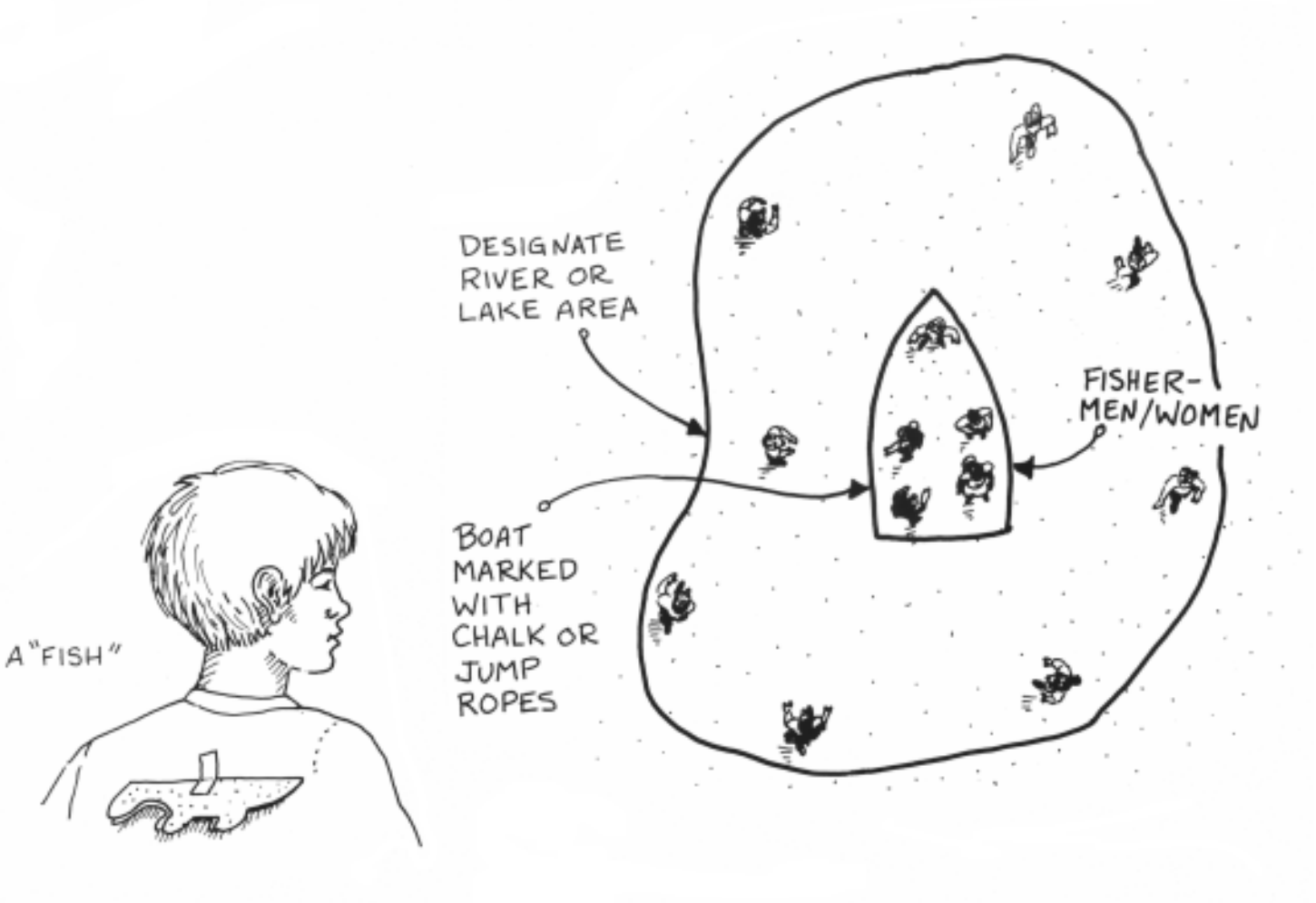
I. Setting the stage

Share the background information with the students (as appropriate). Remind them that when clean water becomes polluted, it can cause diseases and upset the balance of nature. This requires people to set standards for water quality.

II. Activities

A. Take the students outside to play the "Going Fishing Game."

1. Divide the class into three equal groups. One group will be the fishermen/women. Take the other two groups aside. They will not know if they are healthy fish or unhealthy fish. Each one will get a folded paper cut in the shape of a fish taped to his/her back. Half will be healthy fish with nothing written on the inside. The other half will have one of these notes written inside (where the fishermen can't see them): "I ate PCBs," "I ate pesticides," "I ate dioxin," "I ate mercury."



2. Designate the area that will be the lake or river. Fish must stay in this area. Designate (using chalk or jump ropes) the "boat" area that will be big enough to contain the whole class. Fishermen/women must start in the boat. On a given signal, fishermen/women start "fishing." They must run after the fish and catch two fish and take them back to the boat. When all the fish are caught and in the boat, the fishermen look inside the paper fish on each fish's back to see if they caught healthy or contaminated fish. If he/she catches 2 contaminated fish, he/she will not be dining on fresh fish (unless the family goes out to eat!).

3. Ask the students how many will be going out to eat. Should there be a sign at this lake that says, "No fishing"? (yes)

B. Have the students write a story about "My Imaginary Trip to (lake, ocean, river — whatever is near you)." Teach paragraphing by using the following topics:

1. Planning my trip

2. Packing for the trip

3. Arriving at the beach and seeing a "No Swimming — Polluted Water" sign posted

4. Feeling disappointed

5. (Optional) What I did instead of going swimming.

III. Follow Up

A. Ask the students what it means when a “No fishing” or “No swimming” sign is posted. Does this always mean the water is polluted? (No; it could mean something else, e.g., this lake is on private property and the owner doesn’t want you to do these things.) Tell them that if the water is polluted, or if there is some other possible danger there, the signs will explain it.

B. Remind the students that the first goal of the laws to protect the environment is to protect people’s health. Discuss with the students how they should react when they see a sign prohibiting fishing or swimming. Would they do it anyway? Why or why not?

C. (Optional) Have the students write a paragraph on what they learned in this lesson.

IV. Extensions

A. Have the students make signs like “No Fishing Allowed,” “Polluted Water,” “No Swimming,” “Contaminated Water,” and so on, and illustrate them.

B. Have them research places where water bodies have been closed to fishing and/or swimming and locate them on a U.S. map. (Or find out if any nearby waters have been closed to fishing and/or swimming.)

C. Have each student write a creative story or draw a cartoon in which he/she is a fish. Have them decide what species of fish they are, where they live, and what they eat, making up names for themselves and the lakes in which they live. (NOTE: Remind students these are proper nouns.) In the story or cartoon, have the fish fight water pollution.

RESOURCES

Lucas, Eileen, Water: A Resource in Crisis, Childrens Press, Chicago, 1991, p. 52.

“Water Quality Fact Sheets,” Tennessee Valley Authority, TVA/ONRED/LER, 1988.

CLEANING UP

OBJECTIVES

The student will do the following:

1. Identify ways to prevent surface water pollution.
2. Simulate the removal of pollutants from water by filtration.
3. Compute the area of an illustrated pond.

SUBJECTS:
Science, Math

TIME:
50 minutes

MATERIALS:
cotton balls
toothpicks
clear plastic straws (large) or tubing
activated charcoal
water
plastic cups
spoons
food coloring
eyedroppers
scissors
metric rulers
student sheets (included)

BACKGROUND INFORMATION

For years people believed that materials dumped into water supplies would decompose or be diluted to the point that they were virtually harmless. It has been shown that unlimited and unmonitored dumping of wastes can be very harmful to water supplies. The vast quantities of industrial and human wastes produced must first be treated, either physically or chemically, before they are allowed to re-enter lakes, streams, rivers, and oceans. Bodies of water cannot clean themselves as fast as people pollute them — so people must try to keep pollution out of water.

Terms

cooling pond: a pond where hot water from factories and power plants is stored until it is the same temperature as nearby bodies of water.

diluted: reduced in strength.

industrial pond: a pond used to hold dirty water until it is clean enough to be put into a nearby body of water.

pollution: contaminants in the air, water, or soil that cause harm to human health or the environment.

ADVANCE PREPARATION

A. Preparation of Materials: Use large diameter clear straws or clear tubing for this activity. Cut the straws in half. Finely crush the charcoal. Pour food coloring into small dropper bottles. Activated charcoal may be purchased wherever aquarium supplies are sold; you may buy capsules of activated charcoal at the pharmacy. If activated charcoal is not available use regular charcoal, but crush it very fine before using it.
B. Wide clear plastic tubing may be used in place of large-diameter straws.

C. Provide a spoon and small paper cup for the Organizer to obtain the charcoal. One small bottle of food coloring can be shared by the entire class. At the end of the period, the straws, cotton and charcoal should be placed in solid waste receptacles. Water and food coloring may be flushed down the drain. Cups and droppers should be rinsed.

D. An alternative approach to doing the activity is to do it as a teacher demonstration for lower grades. Use a large piece of clear plastic tubing or a buret borrowed from a high school chemistry teacher.

E. Make copies of the student sheets. (You may prefer to make transparencies of "Water Pollution Solution" and "Plant's Pond.")

PROCEDURE

I. Setting the stage

A. Tell the students a story about a boy or girl whose room is really messy. Describe in comical details how dirty the room is and what a big job it will be to clean it up. Then ask the students what the owner should do. Keep probing until someone suggests that he/she should not let the room get so dirty; keeping it neat is less work than a big cleaning job.

B. Tell the students that water pollution has become one of the most serious environmental problems facing the United States as well as countries around the world. Industry, government, cities, and towns have spent billions of dollars on research and treatment plants to try to reduce water pollution. Three chief sources of water pollution are: industrial (factories) wastes, municipal (city) wastes (sewage), and agricultural (farm) chemicals and wastes. Oil spills are another source of pollution. This activity will help you realize how hard it is to clean up polluted water.

II. Activity

A. Ask the students to think of ways we could clean polluted water. Write their answers on the board. Direct their responses to the idea of filtering. Tell them they are going to work in teams to investigate filtering.

B. Divide the class into teams of at least five. Each group will have an organizer, investigator, manager, recorder, and reporter.

1. Have students draw numbers for the following roles:

a. Investigator - manipulates materials

b. Organizer - gathers and organizes materials, directs the cleanup

c. Manager - helps investigator, keeps time, makes sure safe procedures are followed, performs calculations, and encourages the team

d. Recorder - writes down the team's observations and answers to questions, and makes drawings as needed

e. Reporter - shares the team's results and conclusions with the class.

2. Give each student a copy of "Trying to Make It Clean and Clear."

3. Remind the students to use a very tiny piece of cotton to plug the straw. If the cotton is too dense, the water will not pass through the straw.

4. Tell the students to hold the dropper at an angle when dropping colored water into the straw.

5. Instruct the students to collect water filtered through cotton in cup B, and water filtered through cotton and charcoal in cup C.

C. Ask the designated student(s) in each team the questions below.

1. Manager, Recorder: How does the color of the water in cup B compare with that in cup C? (The water in cup B will still be colored, while the water in cup C will be clear.)

2. Investigator, Recorder: What could account for any difference in color? (Since the only difference between the two setups was the charcoal, the charcoal must have removed color from the water.)

3. Reporter: How do your results compare with those of your classmates? (NOTE: Results should be alike.)

D. Discuss with the students how the experiment they did relates to cleaning up pollution.

1. Does filtering work (at least for some kinds of pollutants)? (yes)

2. What if you had a whole lake full of polluted water? Would filtering it be practical? (no)

3. What might you do to clean the whole lake? (Accept all answers, asking for their reasons.)

4. Some pollutants cannot be filtered out of water. How might you clean water polluted with unfilterable pollutants? (Accept all answers; ask for reasons.)

5. Remind the students of the messy room story. What can we conclude about cleaning up pollution? (It is better to prevent pollution than to have to clean it up.)

E. Demonstrate that pollution does not "just disappear."

1. Set aside several cups having various amounts of food coloring in small quantities of water. Make sure that one is so dilute that the color is not readily observable.

2. Let them sit for a couple of days or until the water evaporates. Let the students observe the residue left when the water evaporated.

3. Put a drop or two of water into each cup to reconstitute the food coloring. They will see that the "pollution" remains, even though the water comes and goes.

4. Discuss with the students that even if people clean up water pollution, they still must do something with the pollutants. This is a very difficult problem.

III. Follow-Up

Have the students complete the “Water Pollution Solution” student sheet. The answers are: 1. F, 2. no, 3. charcoal, 4. F, 5. cotton and charcoal, 6. F, 7. fish, 8. F, 9. prevention, 10. (answers will vary).

IV. Extensions

A. Take a field trip to a wastewater plant. Tour the treatment facility. Have the students develop a list of questions to ask about the plant beforehand.

B. Hold a debate about an environmental issue, such as uses of pesticides, sewage treatment, or thermal pollution. Each issue has pros and cons. Allow students time to research the point of view they are to represent. Establish debate rules and procedures before beginning.

C. Have the students complete the student sheet “Plant’s Pond.” (Answer: 360 sq. meters.)

RESOURCES

Cohen, M. R., T. M. Cooney, and C. M. Hawthorne, Discover Science, Scott, Foresman and Company, Glenview, Illinois, 1991.

Mallinson, G. G., J. B. Mallinson, Linda Froschauer, and J. A. Harris, Science Horizons, Silver Burdette & Ginn, Morristown, New Jersey, 1991.

TRYING TO MAKE IT CLEAN AND CLEAR

1. Investigator: Pull a small piece of cotton from a cotton ball. With a toothpick or paper clip, stuff this piece into one end of each of the two straws. In one straw pour a layer of charcoal 1 cm high. The charcoal should be above the cotton.

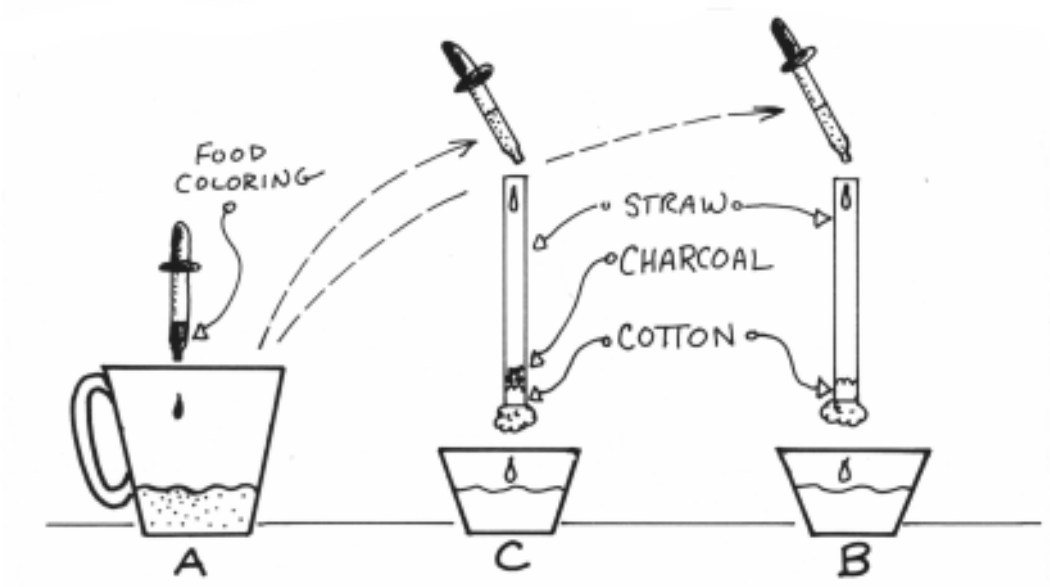
2. Manager: Fill a plastic cup, cup A, 1/3 full of water. Add 1 drop of food coloring. With the eyedropper, mix the food coloring and water thoroughly.

3. Investigator, Manager: Using the eyedropper, add colored water to the straw that has only cotton in one end. Catch the water dripping from the straw in cup B.

4. Investigator: Repeat step 3, using the straw with charcoal and cotton. Collect the water in cup C.

5. Manager: Compare the water color in cup B with that in cup C.

6. Recorder: Record the results.



WATER POLLUTION SOLUTION

Answer these questions by filling in the blank or circling the correct answer.

1. T F It will be very easy to clean up water pollution.

2. Our experiment showed that we can filter some pollution out of water. Is this always possible? yes no

3. We used cotton and _____ to filter the water.

4. T F It is impossible to clean up water pollution.

5. Which worked better? just cotton cotton and charcoal

6. T F Pollution will disappear if we wait long enough.

7. Which of these is not a source of water pollution?
   factories cities farms fish oil spills

8 T F There is nothing we can do to prevent pollution.

9. What is the very best solution to pollution? _____

_____

10. This is a thinking question. What would you do to clean up water pollution if you were in charge of protecting the environment?

_____

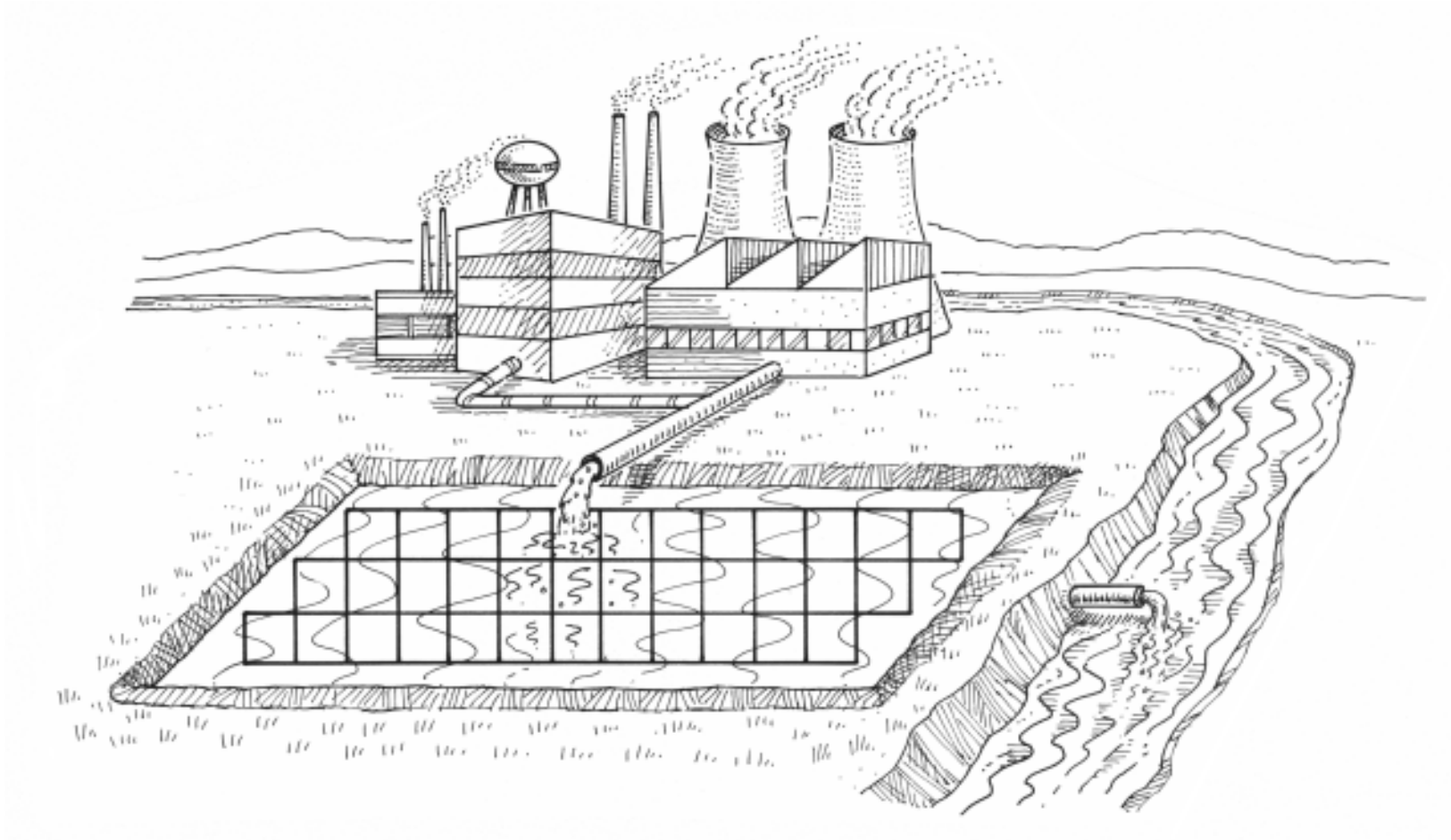
_____

_____

_____

PLANT'S POND

Factories and power plants do many things to keep from polluting lakes and rivers. They store hot water in special ponds called cooling ponds. When the water cools, it can safely be released. They store dirty water in special ponds called lagoons. When the dirt settles out, the clean water can be released.



If the diagram represents a pond and each square is ten square meters, what is the area of the plant's pond? _____

ACID RAIN, GO AWAY!

OBJECTIVES

The student will do the following:

1. Define acid rain.
2. Simulate the effects of acid rain on limestone.
3. Write a paragraph about life in a dying lake.

SUBJECTS:
Science, Language Arts

TIME:
60 minutes

MATERIALS:
vinegar
cups (4 per team)
marble chips
regular chalk (not "dustless")
water
safety goggles
student sheet (included)

BACKGROUND INFORMATION

"Acid rain" is the term used to describe the result of a chain of complex chemical, atmospheric, and environmental processes that start with air pollutant emissions from utilities, industries, and motor vehicles, as well as natural sources (like volcanoes). When rain mixes with certain kinds of smoke and pollution in the air, acid forms. When these substances fall with rain, it is known as "acid rain." Acid rain can slowly do damage by killing plant life and water-dwelling creatures, and by damaging metal and stone, such as that in statues and buildings.

The air pollutants that result in acid rain are sulfur oxides and nitrogen oxides. The major source of sulfur oxides are coal-burning power plants and industrial boilers. The major sources of nitrogen oxides are automobiles and coal-fired boilers at power plants and industries

The most cost-effective (and the only reliable) solution to the problem of acid rain is to control the offending pollutants at their source. The goal must be to emit fewer sulfur oxides and nitrogen oxides into the air so that fewer acids form in the atmosphere. Today power plants and industries emit a small fraction of what they did years ago. As pollution control technologies improve, and as society's commitment to environmental quality grows, we will emit even fewer acid-forming pollutants.

Terms

acid: a kind of chemical; acid in food is sour, sharp, or biting to the taste.

acid rain (or acid precipitation): rain with a pH of less than 5.6; results from atmospheric moisture mixing with sulphur and nitrogen oxides emitted from burning fossil fuels; may cause damage to buildings, car finishes, crops, forests, and aquatic life.

acidic: tending to form an acid.

pollutant: an impurity (contaminant) that causes an undesirable change in the physical, chemical, or biological characteristics of the air, water, or land that may be harmful to or affect the health, survival, or activities of humans or other living organisms.

vegetation: plant life.

ADVANCE PREPARATION

A. Gather the materials needed. Note that the chalk must be regular chalk, not "dustless." Obtain marble chips wherever landscaping supplies are sold.

B. Make copies of the student sheet "Acid Rain, Go Away!"

PROCEDURE

I. Setting the stage

A. Have the students imagine they are on a trip to some mountains far away. They want to visit a beautiful lake they once saw in a picture. Describe a trip from where you are located to such a place. Tell the students that when they arrive at the lake, it looks even more beautiful than in the picture. The lake is deep, clear, and very blue; it reflects the sky perfectly. Describe how quiet and serene it is there. Then introduce an ominous note by saying that it is "too quiet."

Describe how the students would start to notice that there were no fish jumping in the lake, no frogs "ribbet"-ing along the shore, and no dragonflies buzzing about the edge of the water. Because they have been good science students, they know that a lake should have all kinds of creatures and plants in and around it. As they start to examine the lake, they find no living things in the water — just some old shells, insect cases, and dead moss. This lake is dead!

Ask the students what they think happened. How could such a crime have been committed? Who is the murderer of the lake? Tell them they will learn to be better environmental detectives in this lesson.

B. Continue the story by telling the students that just as they are discussing what happened to the lake, they hear someone coming. (Could it be the criminal?) The students look for a place to hide, but before they can hide, Ranger Dave rides out of the forest on his faithful horse, Giddyup. He waves and smiles. The students are relieved. They crowd around as he climbs down from his mount, asking him about the dead lake. The ranger frowns, takes his hat, and says only two words..."Acid Rain." What on earth does it mean? How could rain hurt the lake? How could the rain be acidic? Ranger Dave shook his head and drawled, "You folks best be getting back to class. The next lesson is about acid rain, and if you don't hurry, you're gonna miss it!"

II. Activity

A. Share with the students that sometimes moisture in the air mixes with certain kinds of smoke and other types of air pollution, producing acids in the rainwater; this is known as "acid rain." When acid rain falls, it affects the land it falls on. The worse the problem, and the longer it goes on, the greater effect on the land.

B. Discuss the problem with the students. Acid rain may have recently been in the newspaper or magazines. Scientists cannot say exactly what the effects of acid rain on every place are, but they do know that there are places where acid rain has had serious effects. In Scandinavia and the Adirondack Mountains in the U.S., there are "dead" lakes like the one in our story. In many beautiful and historic old cities, famous buildings and statues seem to be "melting" because acid rain slowly dissolves the stone they are made out of.

C. Have the students explore the effects of acid rain on building materials. They will simulate this process.

1. Divide them into small teams. Give each student a copy of the student sheet "Acid Rain, Go Away!" (included), and have them complete this activity. They are to follow the directions on the student sheet. While they are waiting the 15 minutes, have them look up these terms in their dictionaries and write the definitions down.

    a. pollutant

    b. acid rain

    c. vegetation

    d. acidic

    e. acid

2. Ask, "How did vinegar affect the chalk?" Explain to the students that they should see a noticeable dissolving effect because the acid in vinegar will react with the calcium in chalk.

3. Ask, "How did the vinegar affect the marble chips?" Explain that the vinegar does not affect the marble chips as noticeably, although they too contain calcium. Stress that the (sulfuric) acid in rain is different from the (acetic) acid in vinegar, so the effect is not exactly the same. This is a simulation—something like what really happens.

D. Tell the students that acid rain affects water environments, too. Over a long period of time, a lake's water can collect acid and other chemicals (e.g., metals that acidic rainfall leaches out of soil around the lake) that are harmful to the living things in the water. If the problem becomes severe enough, the smallest animals and plants will die first; then the larger animals will die. Finally, nothing will be alive in the lake.

E. Have the students research local newspapers to find out if acid rain or snow is a problem in your area. What are the causes and possible solutions?

III. Follow-Up

Have the students imagine that they are fish living in a lake where there has been acid rain. Have them write a paragraph describing their experiences. Ask them to answer the question "What is life like for you in your lake?" What is happening to you, your neighbors, and your home?"

IV. Extensions

A. Have the students write their senators and representatives about the problem of acid rain.

B. Contact the Environmental Protection Agency or your state's environmental protection office for information about acid rain.

RESOURCE

Hackett, J. K. and R. H. Moyer, Science In Your World, Macmillan/McGraw-Hill, New York, 1991.

ACID RAIN, GO AWAY!

1. Label four plastic cups A, B, C, & D.
2. In cup A place a piece of chalk in water.
3. In cup B place some marble chips in water.
4. In cup C place some marble chips in vinegar.
5. In cup D place a piece of chalk in vinegar.
6. Now stand back and wait. After 15 minutes, examine the materials in the cups.
7. What has happened in cup A? _____

_____

8. What has happened in cup B? _____

_____

9. What has happened in cup C? _____

_____

10. What has happened in cup D? _____

_____

Vinegar has acid in it, though not exactly like the acid in pollution. Notice what it does to the chalk in cup D. The acid in acid rain is not the same strength as that of vinegar, so the effect in nature will occur at a different speed than in your test, but in the end the effect is similar.

11. How might acid rain affect buildings and monuments? _____

_____

12. What might the acid do to trees and plants? _____

_____

13. Judging from the activity, would you say tap water has acid in it? _____

_____

14. Define acid rain. _____

_____

_____

N, B, & T: POLLUTANTS THREE

OBJECTIVES

The student will do the following:

1. List and describe three types of surface water pollution (nutrient, bacterial, toxic).

2. Observe the effects of various water pollutants on algae growth.

3. Illustrate a cause of each of the three types of pollution.

SUBJECTS:
Science, Art, Language Arts

TIME:
60 minutes

MATERIALS:
5 baby food jars with lids
six 2-liter plastic bottles
gallon (4 L) milk jug
water
soap or detergent
vinegar
flea powder
food scraps
five 3-liter plastic bottles (clear, not tinted)
pond water
teaspoon
crayons or markers
student sheet (included)

BACKGROUND INFORMATION

Nutrients from fertilizer have been major water pollutants since the 1940's. Although plants and animals need these for growth, if there is too much phosphorus and nitrogen in water, algae and other aquatic plants grow too rapidly. Rapidly growing plants in water also means more plants die and decay, and in the process they use up the oxygen dissolved in the water. As a result, fish and other aquatic life die.

Another major water pollutant is human and animal wastes. Lakes and beaches are often closed to swimmers and anglers because of high counts of fecal coliform bacteria from raw sewage (human waste) and feedlot runoff that makes its way into rivers and streams then empties into the lakes and oceans. Although coliform bacteria are not harmful themselves, they usually indicate that pathogens, disease-causing organisms, are present.

The third major type of water pollutant is toxic, or poisonous, chemicals. Toxic pollution is most often from pinpointable sources, such as industrial discharges or accidents in transportation (such as oil spills). It can also come from less identifiable sources, including runoff from both urban and rural areas, and fallout from the atmosphere.

The sources of pollutants that cause water pollution vary. In some cases, pollutants may come from a pipe discharging into a river, a boat, irrigation ditch, underground storage tank, or other single source, called a "point source" of pollution. But frequently they are varied sources, collectively called a "nonpoint source," that could include industries, agriculture, and other human activities.

Point source problems are the easiest to correct. Their cause—wastewater emptied into the lake through a pipe—can be dealt with directly. Nonpoint source problems are more difficult to fix. Fixing nonpoint source problems usually requires a lot of cooperation by every part of society.

Terms

bacterial water pollution: the introduction of unwanted bacteria to a water body.

conservation: preserving from loss, waste, or harm.

erosion: the wearing away of the earth's surface by running water, wind, ice, or other geological agents; processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is removed from the earth's surface.

fertilizer: any one of a large number of natural or synthetic materials, including manure and nitrogen, phosphorous, and potassium compounds, spread or worked into the soil to increase its fertility.

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

nutrient pollution: a nourishing contamination that causes unwanted plant growth in water.

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

pollutant: an impurity (contaminant) that causes an undesirable change in the physical, chemical, or biological characteristics of the air, water, or land that may be harmful to or affect the health, survival, or activities of humans or other living organisms.

pollution: contaminants in the air, water, or soil that cause harm to human health or the environment.

sewage: human waste.

toxic pollution: harmful, chemical contamination in water.

ADVANCE PREPARATION

A. Cut the tops off the five 3-liter bottles. (Scissors work fine. Just cut the top section off each, and recycle.) You may use large, clear jars as long as all of them are exactly the same.

B. Take five 2-liter bottles to a pond, lake, or river, and fill each with water.

C. Gather the other jars, bottles, and so forth, and the "pollutants."

D. Run a jar (approximately a pint, or 500 mL) of tap water and let it set overnight so the chlorine will dissipate.

E. Copy the student sheet for distribution.

PROCEDURE

I. Setting the stage

A. Ask students to guess how much water they use each day. Then tell them that each person in the United States uses about 150 gallons (570 L) of water each day for drinking, bathing, cleaning, flushing the toilet, watering lawns, and so on. Provide a gallon (4 L) milk jug and a 2-liter soft drink bottle of water to show gallons and liters of water.

B. Point out to the students that while we progressed as a nation we became very careless with our water. Farmers used chemicals to help crops grow and kill insects, and later the rain and snow washed these chemicals into streams and lakes. Factories made many useful products from chemicals, such as medicine, clothes, automobile lubricants, and household goods. Water was always used in the process, and wastewater was discharged into streams. People added pollutants to water when they used it in their homes. They added soap, toothpaste, shampoo, bleach, detergent, fertilizers, insect spray, human wastes, paint, oil, grease, plus many more. Tell the students many of these activities continue today.

C. Emphasize to the students that people thought that because rivers and lakes had so much water, they could clean themselves. We now know that a little here and a little there can eventually add up to a lot. In the '60s, lakes and streams were overnourished with phosphorus that came from detergents; they became choked with algae. Nutrients from fertilizers and untreated sewage added to the problem. Fecal coliform bacteria from raw sewage flowing into the lakes and streams caused a lot of beaches and lakes to be closed. Now we know that we must clean water before it can be used again; we pollute bodies of water too much for them to clean themselves.

II. Activity

A. Have the students list sources of each of the three categories of pollutants (nutrient, bacterial, toxic).

1. Write the three categories on the board. (These are the “N, B, & T” pollutants to which the title refers.) Make them headings for columns.

2. Ask the students to identify the kinds of substances causing each kind of pollution. Lead them to summarize: nutrient - fertilizer, bacterial - human waste, toxic - chemicals. Write these terms beside the headings.

3. Have the students list as many sources as possible for each of the three kinds of pollution. Write their answers in the columns.

B. Do this activity to show that a little pollution here and there can do harm.

1. Prepare “pollutants” to mix with the pond water. Have the students help you measure, mix, and label them. Use the tap water you have let set to dechlorinate. Mix the following in small jars (e.g., baby food jars).

a. Pour 1/4 cup (60 mL) of plain water into the first jar. You will not add a pollutant to this jar.

b. Mix a scant half-teaspoon (2-3 mL) soap or detergent and water (1/4 cup or 60 mL).

c. Mix a solution of vinegar (1-1/2 ounces or 45 mL) and water (1/4 cup or 60 mL).

d. Mix a scant half-teaspoon (2-3 mL) of flea powder and water (1/4 cup or 60 mL).

e. Mix a scant half-teaspoon (2-3 mL) food scraps and water (1/4 cup or 60 mL). (NOTE: You may want to avoid using any meat scraps because they will become very smelly.)

2. Use five 3-liter plastic bottles (with the tops cut off) or other clear containers. Fill each "pond model" with pond water. They will be identical; then add one of the following to each. As you do this, point out to the students that the models are just alike except for the pollutants added to them. This is very important in an experiment. Identify each as to its pollution category.

   a. Add the plain water.

   b. Add the mixture of soap and water. This represents nutrient pollution.

   c. Add the solution of vinegar and water. This represents toxic pollution.

   d. Add the mixture of flea powder and water. This represents toxic pollution. The powder is similar to the chemicals used to kill pests on crops.

   e. Add the food scraps and water. This represents bacterial pollution; the bacteria will break the food down.

3. Label the models with treatment type and the date and time of the treatment.

4. Have the students predict what will happen to each.

C. Ask the students what a "monitor" is. (someone who keeps a check on something) Ask them to give examples. Tell them they will be "monitoring" the progress of the models. Tell them scientists monitor our water for water pollutants. This helps keep us safe from polluted water.

D. Have the students observe daily and record any differences in growth and development of the algae for about 10 days to two weeks. (NOTE: If the smell becomes too unpleasant in the food scraps pond, you may have to discard it.). Discuss their observations. (The model plain water was added to should look the same, the vinegar and flea powder should show no growth [toxic], the detergent should have extensive growth of algae [nutrient], and the food scraps should be smelly [bacteria].) Can the students explain these results in light of what was added? (Algae and algae spores were present in the pond water that was collected for the experiment.)

E. When you are through observing the pond models, the algae and water (with the additives) may be safely flushed down the toilet.

III. Follow-Up

A. Have students complete the sheet "A Little Here and There is Too Much."

B. Have students write a poem or a song about the N, B, & T Pollutants (Nutrients, Bacteria, Toxics)

IV. Extension

A. Have the students imagine they are each the governor of a state. They are having three major problems: 1) Businesses are discharging hazardous wastes into the lakes; 2) Farmers are using chemical fertilizers that run off into the rivers; and 3) The sewage treatment plant leaks raw sewage into the rivers. Have the students write ways they would take care of these concerns. (NOTE: Younger students might act out their solutions to these problems.)

B. Have the students examine local newspapers to find out what their community's major water pollutants are.

RESOURCES

Elick, C., "Water," Tennessee Conservationist -Student Edition, Nashville, Tennessee, January/February, 1988.

Gay, K., Water Pollution, Franklin Watts, New York, 1990.

Holmes, N. J., et al., Gateways to Science: Grade 5, Webster Division, McGraw-Hill, New York, New York, 1985.

"Your Lake Is Unique," RiverPulse, Tennessee Valley Authority, Water Resources Division, July 1992.

A LITTLE HERE AND THERE IS TOO MUCH

Draw a picture to illustrate a cause for each kind of pollution.

NUTRIENT POLLUTION

F
E
R
T
I
L
I
Z
E
R
S

BACTERIAL POLLUTION

S
E
W
A
G
E

TOXIC POLLUTION

C
H
E
M
I
C
A
L
S

STOP THAT SEDIMENT

OBJECTIVES

The student will do the following:

1. List soil conservation methods.

2. Identify sediment as a result of soil erosion and a water supply problem.

3. Demonstrate contour farming, windbreaks, and terracing as erosion prevention methods.

SUBJECTS:
Science, Social Studies

TIME:
100 minutes

MATERIALS:
1 quart (liter) jar or 2 liter bottle
sand
topsoil
pea gravel
world map or globe
acetate sheet
overhead projector
teacher sheet (included)
three plastic-lined boxes
sphagnum moss (or rye grass seed)
three 1-liter plastic bottles or large spray bottles

BACKGROUND INFORMATION

When it rains or when snow thaws, the water in a river becomes muddy. The water is carrying sediment. Sediment is picked up by the water on its way over the land and through the stream channels. Water is in contact with the soil nearly everywhere. Some times and in some streams, the water carries more sediment than at other times or in other streams due to varying amounts of precipitation and varying land slopes. Sediment is a water supply problem because when water is to be used for municipal supply or for industry, sediment in it must be removed and disposed of.

Erosion is the carrying of soil from one place to another by water and wind. It is a natural process but people have accelerated its pace. Much erosion results from the removal of vegetation from the land. For example, forests can be completely removed to make room for farms or to harvest timber or firewood (people in many developing countries depend on wood for heat and cooking).

In developing countries, erosion is a growing problem because there is pressure to develop and people lack the knowledge and means to implement environmentally-sound agriculture practices. The resulting lack of vegetative cover (with spreading roots to help hold soil) increases the loss of topsoil by wind and water. To slow soil loss by wind erosion, farmers can put rows of trees — windbreaks — between their fields. Farming methods can prevent erosion. For example, plowing up and down a slope causes erosion. A better method, called contour farming, is to plow horizontally across the face of a slope. Another method is called terracing, in which a farmer builds a series of level plots in step-like fashion on the slope. Contour farming and terracing slow runoff and allow water to soak into the soil.

Across the world, topsoil is being lost at a yearly rate of up to 10 times the rate at which new soil forms.

Terms

contour farming: plowing horizontally across the face of a slope.

erosion: the wearing away of the earth's surface by running water, wind, ice, or other geological agents; processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is removed from the earth's surface.

sediment: insoluble material suspended in water that consists mainly of particles derived from rocks, soil, and organic materials; a major nonpoint source pollutant to which other pollutants may attach.

terracing: a series of level plots in step-like fashion on a slope.

topsoil: the rich upper layer of soil.

windbreak: rows of trees between fields to prevent loss of soil by wind.

ADVANCE PREPARATION

A. Prepare three plastic lined boxes ahead of time. (Empty soda boxes [that hold 24 cans] lined with plastic garbage bags work well.) Half fill each box with soil. (Use regular topsoil, not commercial potting soil.) These will be used by the students to demonstrate contour farming, windbreaks, and terracing as methods of erosion prevention.

B. Have enough sphagnum moss for each team to successfully complete its project. You may have the students sew rye grass seed if you wait about a week for it to sprout.

C. Make a transparency of the teacher sheet, "Soil Conservation." If this isn't practical, each team should have a copy for reference.

D. To demonstrate sediment, fill the quart (liter) jar with water and have the "sediment samples" (one handful each of pea gravel, sand, and soil) nearby. Your students may be able to see it better if you use a 3-liter bottle.

E. You will need to fill, or ask a student to fill, the three 1-liter bottles with water. Spray bottles of water are more efficient in the demonstrations and less messy, but are expensive and will need to be purchased if not available. (Suggestion: Have parents lend them from home. Wash them out carefully before letting the students use them.)

PROCEDURE

I. Setting the stage

A. Ask the students the following questions:

1. Where have you ever seen muddy water? (puddles, rivers, streets, etc.)

2. What do you believe causes the water to become muddy? (Soil washed into it.)

3. How would soil get washed into a water source? (rain, etc.)

B. Show the quart (liter) jar of water.

1. Explain that this jar represents one of the water sources they mentioned.

2. Explain that soil washed into the water is called sediment.

a. Put in the "sediment samples" as you explain this (the water will become muddy).

b. Shake it vigorously and set it down (the soil particles will begin to settle).

c. Observe that large particles settle first and finer particles settle slowly. Wait a few minutes to allow settling that is noticeable, then ask the students to describe the settling.

d. Note that the process of settling took place while the water was still.

e. Shake the jar again. Explain that in a moving stream, the motion of flow keeps stirring up the water and the sediment.

C. Ask the students the following questions:

1. In what ways would sediment in a flowing water source be good? (new fertile land like the Mississippi Delta or along the Nile River) Have the students point these places out on a world map or globe.

2. In what ways would sediment in a flowing water source be a problem? (drinking water, loss of depth in shipping and barge channels, flooding, clogging of streams, loss of fish and other aquatic life)

II. Activity

A. Divide the class into three teams.

B. Write the word "erosion" on the board. Define erosion as the transport of soil from one place to another by water and wind.

1. Ask the students what kinds of actions might result in erosion. (cutting away trees, farming, heavy rains, etc.)

2. Tell the students to think of the box of soil in their group as barren land.

3. Tell the students to blow on one end of the box to show how wind blows away the top layer.

a. Explain that the top layer of soil is called topsoil and is very important to grow vegetation.

b. Ask the students to brainstorm ways to prevent wind erosion.

4. Tell the students to have two people elevate one end of the box to represent a slope.

5. Tell each team to have one student SLOWLY and carefully pour or spray a little water from their bottle across the end (from left to right) to show water erosion. Ask the students to brainstorm ways to prevent water erosion.

C. Show the overhead transparency of the teacher sheet "Soil Conservation" (or pass out copies to each team). Explain the method used in each picture.

D. Assign one of the methods used to each team. (NOTE: You may take the students outside for this activity.)

1. Tell Team One to construct a windbreak across their field using the sphagnum moss.

2. Tell Team Two to construct patterns of contour farming using rows of sphagnum moss and tilting their box to demonstrate a slope.

3. Tell Team Three to build terraces with the soil and "plant" sphagnum moss on each one. (NOTE: The team may need to moisten the soil to perform this task.)

E. After each team completes its task, ask them to again blow across the "field" to simulate wind erosion. (NOTE: Team Three should blow from the top to the bottom of their terrace.)

F. Ask each team to SLOWLY and carefully pour water from their liter bottle to simulate water erosion. (NOTE: Team Three should pour water from the top to the bottom of their terrace.)

G. Observe the differences in runoff.

H. Ask each team to report on its results.

III. Follow-Up

A. Have the students demonstrate their knowledge of soil conservation by performing the following tasks.

1. Explain how water sources get muddy. (water erosion; open, bare fields; etc.)

2. Define sediment. (tiny bits of rocks, soil, and other materials washed into water sources)

3. Name some problems associated with sediment. (flooding, contaminated water supplies, etc.)

4. Define erosion. (the transport of soil from one place to another by water and wind)

5. Name three ways to prevent soil erosion. (windbreaks, contour farming, and terracing)

B. Have the students write a paragraph in which they tell of a terrible rainstorm and a community's resulting problems with muddy water. Tell them to choose one particular problem (e.g., bad taste, dirtying of laundry) that would occur and let them make up the source of the eroded soil and what could be done to stop the soil loss. (Review paragraphing with them first.)

IV. Extensions

A. Invite a soil conservation representative to discuss methods of preventing erosion.

B. Ask the students to draw pictures showing soil conservation and non-conservation farming methods.

C. Have the students research areas of their state where sedimentation in a water source has created problems and present their findings to the class.

D. Ask the students to find articles in magazines and newspapers concerning erosion, sediment, or soil conservation. Create a bulletin board with the articles.

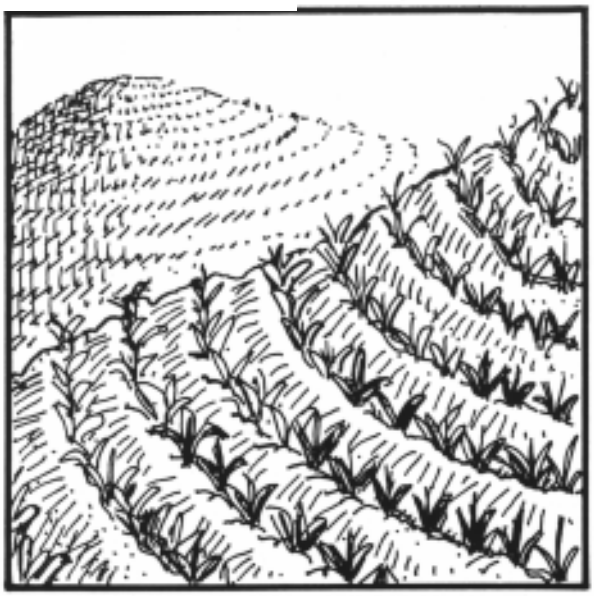
RESOURCES

Cohen, Michael R., Discover Science (Grade 3), Scott Foresman, Glenview, Illinois, 1991, pp. 214-215.

Hurd, Dean, General Science: A Voyage of Exploration (Grade 5), Prentice-Hall Publishers, Englewood Cliffs, New Jersey, 1989, pp. 536-539.

SOIL CONSERVATION

CONTOUR FARMING



TERRACING

WINDBREAK

WORKING TOGETHER TO PREVENT POLLUTION

OBJECTIVES

The student will do the following:

1. Distinguish between point source and nonpoint source pollution.
2. List ways to prevent nonpoint source pollution.
3. Sing a song about working together.

SUBJECTS:
Science, Music, Art

TIME:
90 minutes

MATERIALS:
posterboard (one per group)
old magazines
scissors
glue
markers
crayons
teacher sheet (included)
acetate sheet
overhead projector
student sheet (included)

BACKGROUND INFORMATION

The sources of pollutants that cause water pollution vary. In some cases, pollutants may come from a pipe discharging into a river, from a boat, irrigation ditch, underground storage tank, or other single source, called a "point source" of pollution. But frequently they are varied sources, collectively called "nonpoint sources," that could include pollutants from industries, agriculture, and other human activities.

Point source problems are the easiest to correct. Their causes — wastewater emptied into bodies of water through pipes — can be dealt with directly. Additional treatment can be required, water conservation programs can be started, or other measures can be used to prevent water quality problems.

Nonpoint source problems are more difficult to fix. They result when rain from your lawn, city streets, parking lots, and barnyards runs off into lakes and streams. This runoff may contain oil, fertilizers, antifreeze, pesticides, bacteria, and other substances harmful to water quality. Another type of nonpoint source pollution is erosion of soil from farm lands, construction sites, and stream banks.

Fixing nonpoint source problems usually requires a great deal of cooperation. Communities, farmers, homeowners, forest managers, developers, and companies —all of us— must all take better care of the land to reduce nonpoint source pollution.

Terms

conservation: preserving from loss, waste, or harm.

contaminant: an impurity that causes air, soil, or water to be harmful to human health or the environment.

erosion: the wearing away of the earth's surface by running water, wind, ice, or other geological agents; processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is removed from the earth's surface.

fertilizer: any one of a large number of natural or synthetic materials, including manure and nitrogen, phosphorous, and potassium compounds, spread or worked into the soil to increase its fertility.

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

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

pollutant: an impurity (contaminant) that causes an undesirable change in the physical, chemical, or biological characteristics of the air, water, or land that may be harmful to or affect the health, survival, or activities of humans or other living organisms.

pollution: contaminants in the air, water, or soil that cause harm to human health or the environment.

ADVANCE PREPARATION

A. Gather needed materials. Use travel, outdoor sports, and home and garden magazines for the most appropriate pictures.

B. Make a transparency of the teacher sheet.

C. Copy the student sheet for distribution.

PROCEDURE

I. Setting the stage

A. Begin by asking the students what water pollution is. Help them clarify their definition.

B. Ask them whose fault water pollution is. Discuss the issue of responsibility with them.

C. Tell the students that protecting water quality and controlling pollution is everybody's business! The Clean Water Act gives states the authority to control pollution sources, but each of us must share in the responsibility.

II. Activity

A. Write "point source pollution" and "nonpoint source pollution" on the board. Can the students guess what these mean?

1. Give the students the definition of each term.

2. Ask them to give examples of each one.

3. Ask them which kind of water pollution they would be most likely to cause by their own actions. (nonpoint source) Have them identify some ways they might prevent this. (e.g., not littering, using the right amount of fertilizer and bug spray)

B. Have the students complete the exercise on the teacher sheet "Point or Nonpoint?" (use it as a transparency). These answers are 1.P, 2.N, 3.N, 4.P, 5.N.

C. Give each student a copy of the mini-poster "Do What You Can Do." Discuss it with them. Let the students decorate the sheet. Have them take it home to their families.

III. Follow-Up

A. Have the students work in teams of three or four. Supply them with posterboard, scissors, glue, old magazines, and markers. Each team should prepare a poster display on ways to reduce nonpoint source pollution. Suggest collages of applicable photos and words. Have the teams share their posters. Hang them in local libraries, sporting goods shops, and community centers.

B. Have the students sing the following to the tune of "The More We Get Together."

The more we work together, together, together,
The more we work together, the happier we'll be.
For your lake is my lake and my lake is your lake.
The more we work together, the cleaner it will be.

IV. Extensions

A. Take a field trip to your local lake or river. If there is a dam there, arrange to have someone give your class a guided tour. Have the students ask pre-prepared questions about point source and nonpoint source pollution.

B. Have the students make up more verses to the song. Suggest they use local water bodies and point/nonpoint differentiation in their lyrics.

RESOURCES

Gay, K., Water Pollution, Franklin Watts, New York, 1990.

"Your Lake is Unique," RiverPulse, Tennessee Valley Authority, Water Resources Division, July 1992.

POINT OR NONPOINT

Identify the following as point sources or nonpoint sources of water pollution. Write "P" or "N" in the blanks

1. Leaking underground storage tank _____
2. Neighborhood yards to which weed killer has been applied _____
3. Farmlands to which fertilizer has been applied _____
4. Factory with wastewater discharge pipe _____
5. All the town's construction sites _____

DO WHAT YOU CAN DO

1 Learn as much as you can about your lake or river. Become informed about the conditions there. Ask he state agencies responsible for managing water quality and fisheries.

2 Share your concern about our lakes and streams with others—friends, parents, neighbors, and elected representatives. Join forces to protect and improve water quality by joining a lake association in your area. The North American Lake Management Society can help you start one if there is not a lake association in your area. Write to them at: NALMS, 1 Progress Boulevard, Box 27, Alachua, FL 32615.

3 Take action. Set an example for your friends. Help your family learn about best management practices and apply them in managing their land. Avoid over-fertilizing your lawn. Have your septic tank pumped out occasionally to keep the field lines from clogging and failing. Fence livestock out of streams and properly manage animal wastes. Encourage other relatives to

WATER-WISE LANDSCAPING

OBJECTIVES

The student will do the following:

1. Use the telephone book to find the phone number and invite a guest speaker.
2. Develop interviewing techniques.
3. Read rainfall and seed package maps to compare climate conditions.
4. State the definition of xeriscaping.

SUBJECTS:
Science, Social Studies, Language Arts, Art

TIME:
2 - 4 hours

MATERIALS:
U.S. wall map
reference books
acetate sheets
several telephone books
teacher sheets (included)

BACKGROUND INFORMATION

Xeriscape ("zeer uh scape") is a word coined in 1981. It is so new that it probably is not in a dictionary. "Xeros" is a Greek word meaning "dry." The word "xeriscape" means landscaping that reduces the need for water. This is important because people use so much water to water their lawns, trees, gardens, and ornamental plants such as shrubs and flowers. More than 40 states in the U.S. now have xeriscaping programs.

All plants need water, but different plants have differing requirements for it. For example, houseplant owners know that their potted plants will not thrive (or maybe even survive) if they water them with equal amounts on a set schedule (e.g., once a week). Of course there are many reasons this is true, but one of the main reasons is that different kinds of plants have different needs. The same is true for outdoor plants with which we landscape our houses, schools, and other buildings.

Considering that we often use utility water (for which we pay) to water our landscapes, it makes sense both practically and economically to choose plants that are adapted to our locales' normal rainfall and temperature ranges. In arid areas, it is very important that people not use too much water for landscapes filled with thirsty shrubbery, lawns, and flowers. In those areas, it is especially important that landscapers choose plants that thrive without a lot of watering.

Term

xeriscape: a way of landscaping that reduces the need for water.

ADVANCE PREPARATION

A. Make transparencies from the teacher sheets.

B. Collect enough telephone books so that each team of four has one.

C. Ask your librarian to pull library books with pictures of trees, shrubs, and flowers for a small class library. (NOTE: You may also make use of colorful seed/plant catalogs.)

PROCEDURE

I. Setting the stage

A. Ask the students to list things plants need to live. (water, air, nutrients from soil, sunlight) Write their responses on the board.

B. Ask them how plants get the water they need. (rain, or someone "waters")

C. Tell the students they are going to investigate using plants that do not require much watering.

II. Activities

A. Show the students a transparency of the teacher sheet showing six different species of plants and ask where these plants might grow best.

1. Let the students match the plants with the regions listed on the transparency.

2. The answers are:

Cypress-	Southeastern U.S. (coast)
Cactus-	Southwestern U.S. (desert)
Palm-	Florida & Southern California
Birch-	Northeastern U.S.
Sassafras-	Eastern U.S.
Giant Redwood-	Northern California

3. Let the students locate the areas on a large wall map.

B. Show the students the transparency of the annual average rainfall in the continental United States. Compare major areas of the country. Discuss how climate (including rainfall and temperature ranges) affects the plant species native to any region.

C. Have the students look through the library books (and/or seed catalogs) to find a favorite (1) flower, (2) shrub, and (3) tree that they would like to put in their yards. (NOTE: If a student does not have a yard, substitute the schoolyard or a city park.) They should write the names of these plants on a sheet of paper and make a sketch of each of them.

D. Divide the students into teams of four. Have each team use the telephone book to find the phone number for the County Agricultural Extension Agent. Have one student call and invite your County Extension Agent to come to your school for about 1-1/2 hours. (Set the date and time beforehand.) Be sure the student communicates to the agent that you are studying xeriscaping. (NOTE: Follow up with your own call to the agent.)

E. As a homework assignment, have the students watch the news and pay special attention to a

newscaster interviewing someone. The next day discuss good interviewing techniques.

F. Let the class decide on the logistics of how they can efficiently and effectively interview their County Extension Agent. (For example, they might have 3 x 5 cards listing their questions.)

G. Have an interview session with the County Extension Agent. Be very clear that he/she needs to advise students as to whether their favorite flowers, shrubs, and trees will require too much or receive too much water to grow well in your area. (Don't plant a cactus in Seattle or impatiens in Arizona.)

III. Follow-Up

A. Have the students write in their own words what "xeriscaping" means.

B. Have the students take a tour of the school grounds to evaluate the landscaping. Then have them design an improved landscape for your school. You might have them present this to the principal or the parent-teacher organization.

IV. Extensions

A. "Xeriscaping" is a very new word. Investigate other new words in our language. Talk about how language changes over time.

B. Read the Paul Bunyan story, "Why There Are No Trees on the Desert."

C. Invite a landscaper, horticulturist, or landscape architect to talk to your class about his/her job, plants native to your area, or some other topic related to landscaping.

RESOURCES

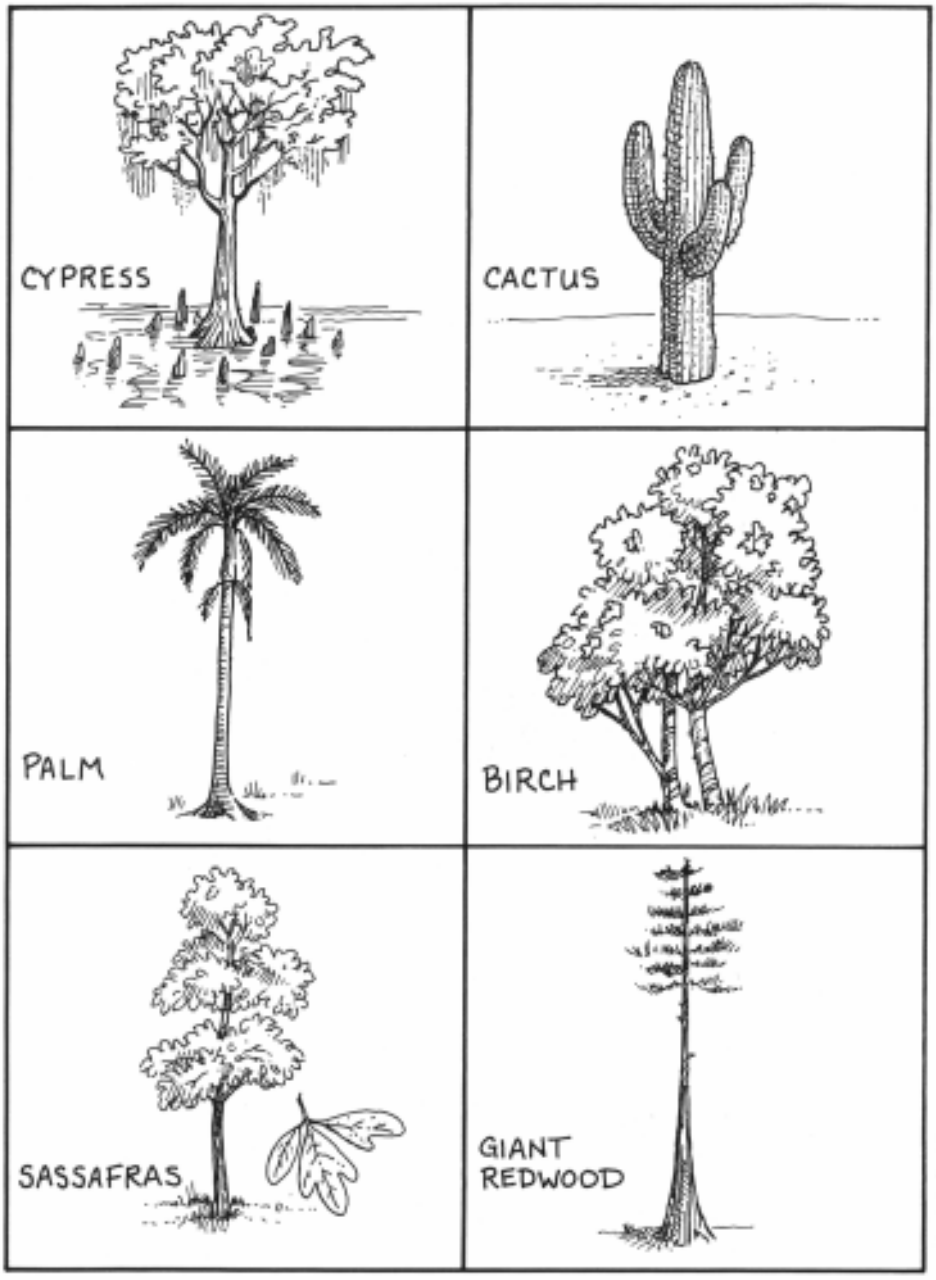
Electronic Geosafari Geography Game, "Biomes card," Educational Insights, Dominguez Hills, California.

Rounds, Glen, "Why There Are No Trees on the Desert," Ol' Paul, The Mighty Logger, Cadmus Books, Milwaukee, Wisconsin, 1949.

Wade, Gary, et al., Xeriscape - A Guide to Developing a Water-Wise Landscape, Cooperative Extension Service, College of Agriculture and Environmental Services, University of Georgia, Athens, Georgia.

WHERE DOES THIS GROW BEST?

Match these kinds of plants with the region in which they grow best.



Northern California

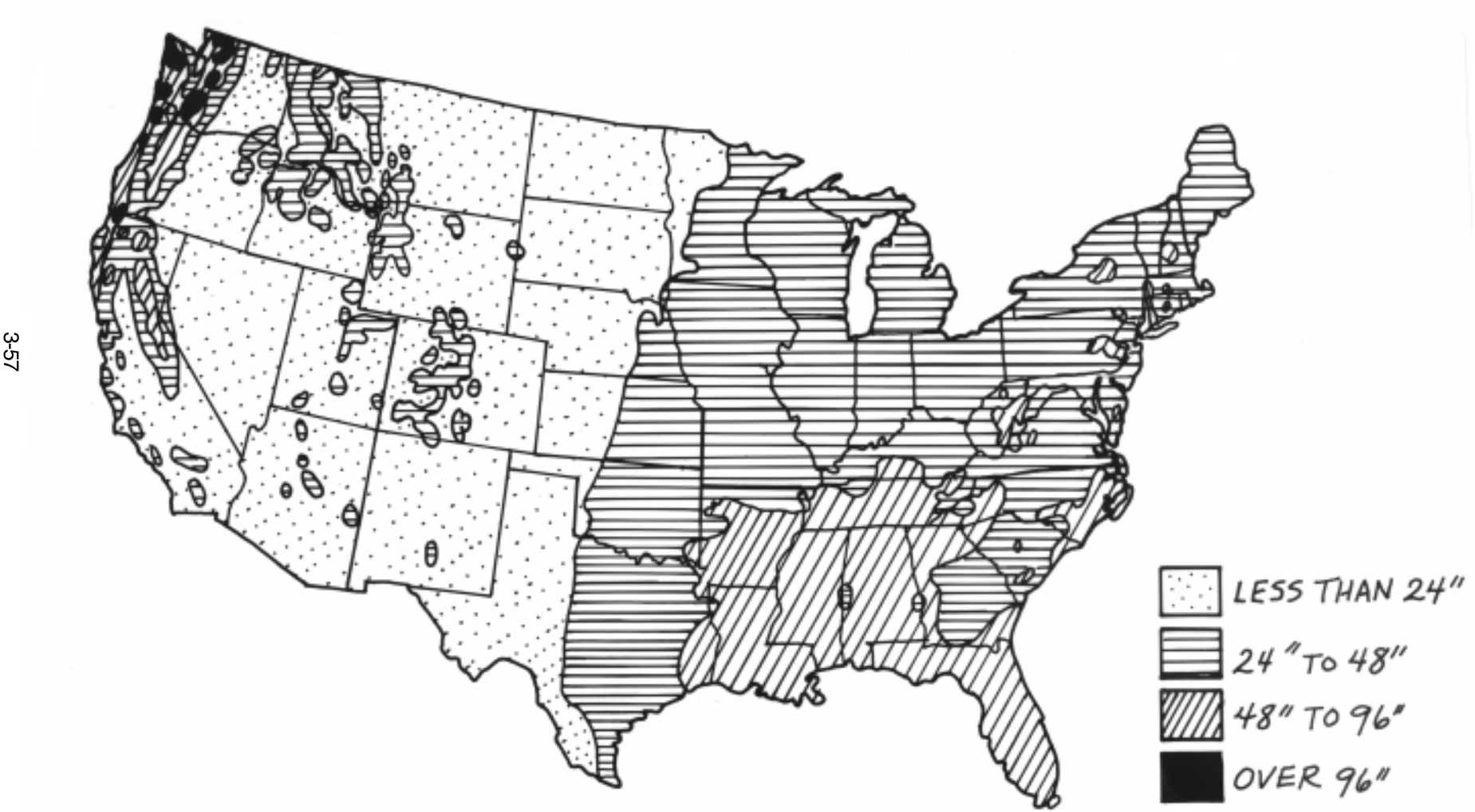
Southeastern U.S. (coast)

Florida & Southern California

Eastern U.S.

Northeastern U.S.

Southwestern U.S. (desert)


LESS THAN 24"
24" TO 48"
48" TO 96"
OVER 96"

WHOSE WATER IS IT?

SUBJECT:
Geography, Social Studies

TIME:
90-120 minutes

MATERIALS:
small pitcher of cold water
one small cup per student
symbols representing each group (e.g., cowboy hats for ranchers, headdress for Indians; optional)
western states map
highlighter
teacher sheet (included)
acetate sheet
overhead projector
butcher paper
markers
pan (optional)
water (optional)
10-25 pounds of non-hardening clay (optional)

OBJECTIVES

The student will do the following:

1. Understand that sometimes it is very difficult to determine what is "fair."

2. Role play holding various viewpoints on an issue.

3. Recognize and state how valuable water is when it is scarce and how this causes social problems.

BACKGROUND INFORMATION

Seven states are drained by the Colorado River. This means that all the rainwater runoff and naturally occurring springs drain eventually to the Colorado River. The Upper Colorado Basin lies in Utah, Wyoming, Colorado, and New Mexico. The Lower Basin lies in California, Nevada, and Arizona. The Colorado River's source is in Rocky Mountain National Park, Colorado. It flows 1,450 miles into the Gulf of California.

Demand for water from the river is high in the dry Southwest. Cities like Las Vegas, Phoenix, Tucson, Palm Springs, and San Diego use water from the Colorado River; it comes through canals or aqueducts, some of which are hundreds of miles long. Agricultural lands have been developed in Southern California and Arizona, where desert once lay, using water diverted from the Colorado River. In addition to these demands there are many ranchers and others who need the river's water. Native American tribal groups claim some of the water for use in their fields and in their communities. By the time the Colorado River gets to Mexico, its flow is a mere fraction of what it otherwise would be; as you might expect, Mexican government officials and farmers are not pleased with this.

There is considerable controversy over who should be able to divert this water and in what amounts. It is very complicated because the issue involves a number of states, two nations, Native Americans, and many other groups (like farmers and ranchers) – not to mention large cities.

Terms

drought: a long period without rain

outflow: where a river flows out to a larger body of water (usually an ocean or sea).

Riparian Rights: water law or doctrine that authorizes the use of water in a stream or river based on ownership of the land adjacent to the river.

source: where a river begins (usually high in mountains).

ADVANCE PREPARATION

A. Obtain a map of the western states. (If you are a member of the American Automobile Association [AAA], you can get some free.)

B. Collect some symbols (Native American headdress, cowboy hat, etc.) to place on groups of desks to indicate where groups will sit.

C. Make a transparency of the teacher page.

D. Prepare a pitcher of cold water just before the lesson.

PROCEDURE

I. Setting the stage

A. After recess when the students are thirsty, distribute a small paper cup to each student. Have on hand a pitcher of cold water. Call on the first row of students to come to the front and drink as many small cups of cold water as they want. If there's any left, call the next row. (NOTE: See how long it takes before someone speaks up about the "unfairness" of this scenario.) After the point has been made, then let the other students get their drinks.

B. First have the students find the Colorado River from source to outflow on a U.S. map or western states map. Use a highlighter to mark the Colorado River. Then ask them what states and cities it goes through. Ask, "Who do you suppose owns that water?" (Encourage lots of discussion.) Now use the transparency on the overhead projector and show them the dams and canals. Discuss what cities the water goes to (especially San Diego and Tucson, a long way away).

II. Activity

A. Role Playing - Divide the class up into groups by drawing names. Groups are: Native Americans (the first ones there), farmers, ranchers, city landscapers, homeowners, environmentalists, recreation enthusiasts, and Mexican citizens.

1. Have them work in their groups to find as many uses for water as they can for the group they are in. Begin by brainstorming. Older students may use reference material from the library (or copies of the magazine articles in the resource section). (Note that the long article is from National Geographic; most libraries have this resource.)

2. Now have the class make a bulletin board. Use an overhead projector to enlarge the teacher sheet of the Colorado River or just hand copy the teacher sheet on the bulletin board. Have each group draw a symbol to locate where they live along the river. (Some groups live all along the river and therefore may make many symbols along the course of the river.)

3. Have them write slogans, make posters/banners, write a speech/advertisement/public service announcement for their needs for the water.

4. Let each group present its most important needs (suggest 3-5 needs).

B. The students will have a mini-debate. Divide the class in half. Explain that they will be role playing

for a few minutes. One group will be the "selfish" group at the upper end of the river. The other group will be the "deprived" group that lives far downstream on the Colorado River. Let each group get together to develop its arguments about its need for water. Each group needs to elect a spokesperson. Remind them again that they are role playing. Let them have a mini-debate over the use of the Colorado River. When they finish, tell them they are through role playing. Each student gets to vote according to how he/she "really" feels. Let the students decide what they will vote on and how to organize the election.

III. Follow-Up

A. Have a discussion on what happened to them as groups. What were their feelings? What about the need for informed decisions? What about laws? What's fair?

B. Have each student write a paragraph on the most fair solution to the problem of allocating the river's water.

IV. Extension

Make a model of the Colorado River using non-hardening clay and water in a plastic pan. Mark off the states with a pencil point and the river with your finger. Indicate where each group lives.

RESOURCES

Carrier, Jim, "The Colorado - A River Drained Dry," National Geographic, Washington, DC, June 1991, pp 2-35.

Gray, Paul, "A Fight Over Liquid Gold," Time, July 22, 1991, Vol. 138, #3, pp 20-26.

Speidel, Ruedisili, and Agnew, eds., Perspectives on Water Uses and Abuses, Oxford University Press, New York, 1988.

THE COLORADO RIVER

POLLUTION PETE PATROL

OBJECTIVES

The student will do the following:

1. Brainstorm recreational uses of surface water.
2. Be aware that federal laws prohibit the dumping of garbage and pollutants into surface water.
3. Simulate the impact of recreational pollutants on surface water.

SUBJECTS:
Science, Art, Social Studies

TIME:
2 50-minute periods

Materials:
drawing paper
crayons or colored markers
10-gallon (40 L) aquarium
pump from liquid soap bottle
plastic caps from soda bottles
plastic 6-pack rings
plastic bags
scissors
glue stick
vegetable oil
used coffee grounds
small toy boat
rubber gloves
fish hooks
fishing line
foods (such as crackers, chips, bread)
milk carton [washed out] from the cafeteria)
posterboard
student sheet (included)
teacher sheets (included)

BACKGROUND INFORMATION

All forms of recreation on and around surface waters have the potential for polluting the water. House-boats pollute with human sewage wastes; boats pollute with garbage, motor oil, and gasoline; boat docks with human wastes, motor oil, and gasoline; boat launching pads and parking areas with run-off oils and gas; campsites with wastewater, garbage, human wastes, and erosion; and swimming with human wastes.

Polluting our waters is against several federal and international laws. The Refuse Act of 1899 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, or any other liquid pollutants) into the waters of the U.S. The Federal Water Pollution Control Act prohibits the discharge of hazardous substances or oils into U.S. navigable waters. The MARPOL Annex V international law restricts overboard dumping of garbage. The U.S. law of Annex V prohibits the dumping of plastic trash and limits the overboard dumping of other garbage.

If you witness a boat discharging oil or hazardous substances into the water (or if yours does) you must notify the U.S. Coast Guard. You must give this information: (1) location, (2) source, (3) size, (4) color, (5) substance, and (6) time observed.

All recreational boats with toilet facilities must have a working marine sanitation device (MSD) on board. The Coast Guard must certify all installed MSDs.

Terms

contaminant: an impurity that causes air, soil, or water to be harmful to human health or the environment.

pollutant: an impurity (contaminant) that causes an undesirable change in the physical, chemical, or

biological characteristics of the air, water, or land that may be harmful to or affect the health, survival, or activities of humans or other living organisms.

recreation: any activity, sport, or hobby that refreshes your mind and body.

ADVANCE PREPARATION

A. Secure a 10-gallon (40 L) aquarium the day before the lesson is taught (may borrow one from a parent) and fill it half full with water.

B. Collect the following items several days before the lesson: pump from a liquid soap bottle, plastic caps from soda bottles, plastic six-pack rings, plastic bags, vegetable oil, used coffee grounds, small toy boat, fish hooks, fishing line, foods (such as crackers, chips, bread), milk carton (washed out) from the cafeteria.

C. Make a copy of the student sheet “Pollution Pete Patrol" for each student.

D. Mix the used coffee grounds with water and put the mixture in the milk carton (only fill 1/3 to 1/2 full so it will float). Seal the end and make a small round hole, with a pencil, in the side of the milk carton to insert the hand soap pump into.

PROCEDURE

I. Setting the stage

A. Lead the students in a brainstorming session on the recreational uses of surface water.

1. List the student examples on the board. (Examples, swimming, fishing, boating, camping, etc.)

2. Add to the list if needed or limit the list if needed. (NOTE: See teacher sheet “Overboard.”)

3. Conduct a survey of the class to determine how many students participate in the listed recreational activities. Graph the results.

B. Have the students create a picture showing as many of the listed activities as they enjoy doing. Give each a sheet of drawing paper.

C. Lead a discussion on how each of the listed activities can pollute surface waters. (Note: See teacher sheet “Overboard” for examples.)

1. After the discussion the students will examine their recreation drawings to identify possible sources of pollution.

2. Give each student a copy of the student sheet “Pollution Pete Patrol.” Let them color the “Pete” symbols.

3. The students will mark the possible pollution sources in their drawings by gluing a cut-out “Pollution Pete” symbol beside the possible pollution sources.

4. Post the drawings around the classroom.

II. Activity

A. Set the half-filled aquarium on a table in front of the class. Explain that the aquarium represents a lake (or other body of surface water). (NOTE: See the teacher sheet "Recreational Pollutants Demonstration.")

1. Ask individual students to name pollution sources they depicted in their drawings.

a. As each student reveals his/her pollution sources, simulate the pollution by adding representatives of the pollution to the aquarium. (NOTE: You might wear rubber gloves.)

b. Continue the process until each student has revealed his or her pollution sources. (NOTE: Repetitive naming of sources will only heighten the visual impact of the activity.)

c. Allow the students to come to the aquarium and observe and smell the water.

B. Ask the students how many of them would like to use this lake for their recreation fun.

1. Ask the students the following questions:

a. What can we do about this pollution?

b. Are there any laws against polluting?

c. What should you do if you see someone polluting the lake?

2. Explain the Refuse Act of 1899, the Federal Water Pollution Control Act and the MARPOL Annex V international law to the students. (NOTE: Use the teacher sheet "Recreational Pollutants Demonstration" for this information.)

C. To extend the student's thinking beyond pollution to the cleaning up of polluted waters, let the students plan some ways to attempt to clean it up.

D. When you are through with your lesson, remove all the solid trash from the aquarium. Throw away what you cannot recycle. The liquid may be discarded down the drain or toilet (try to decant it off the coffee grounds, leaving them in the bottom). Scrape the coffee grounds out. Compost them if possible; if not, put them in the trash. Clean the aquarium with a biodegradable cleanser.

III. Follow-Up

A. Have the students make posters on the theme of "Stopping Recreation Pollution with Pollution Pete." Encourage the students to come up with catchy slogans for their posters.

B. Ask community businesses—especially sporting goods shops, boat shops, marinas, and campgrounds—to display the finished posters.

IV. Extensions

A. Contact a local wildlife, fisheries, or forestry officer to come and talk to your class about recreational pollution.

B. Create pledge cards to join Pollution Pete's Patrol. Have students "join" the patrol and check the

community for any recreational pollution.

C. Invite a newspaper representative to class to see and hear about what the Pollution Pete Patrol is doing to help stop recreational pollution. Have pictures taken of the posters for inclusion in the newspaper.

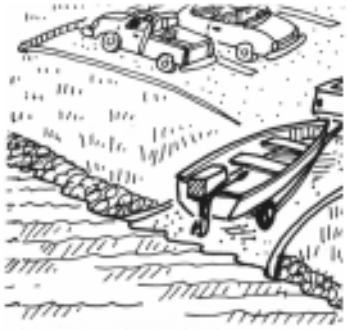
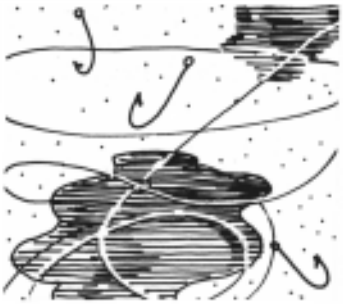
D. Make a study of how pollution affects wildlife. Look carefully at how plastic trash (especially 6-pack rings and plastic bags) affects water-dwelling creatures. For example, birds and marine mammals get plastic rings around their beaks or necks, which causes choking and/or starving. Some animals ingest plastic, which stops up their intestines and starves them.

RESOURCES

Federal Requirements for Recreational Boats, United States Coast Guard, U.S. Department of Transportation.

Kathryn O'Hara/CMC, "Tossing This Trash Overboard Could Leave Death in Your Wake," S & S Graphics, Inc., May 1991.

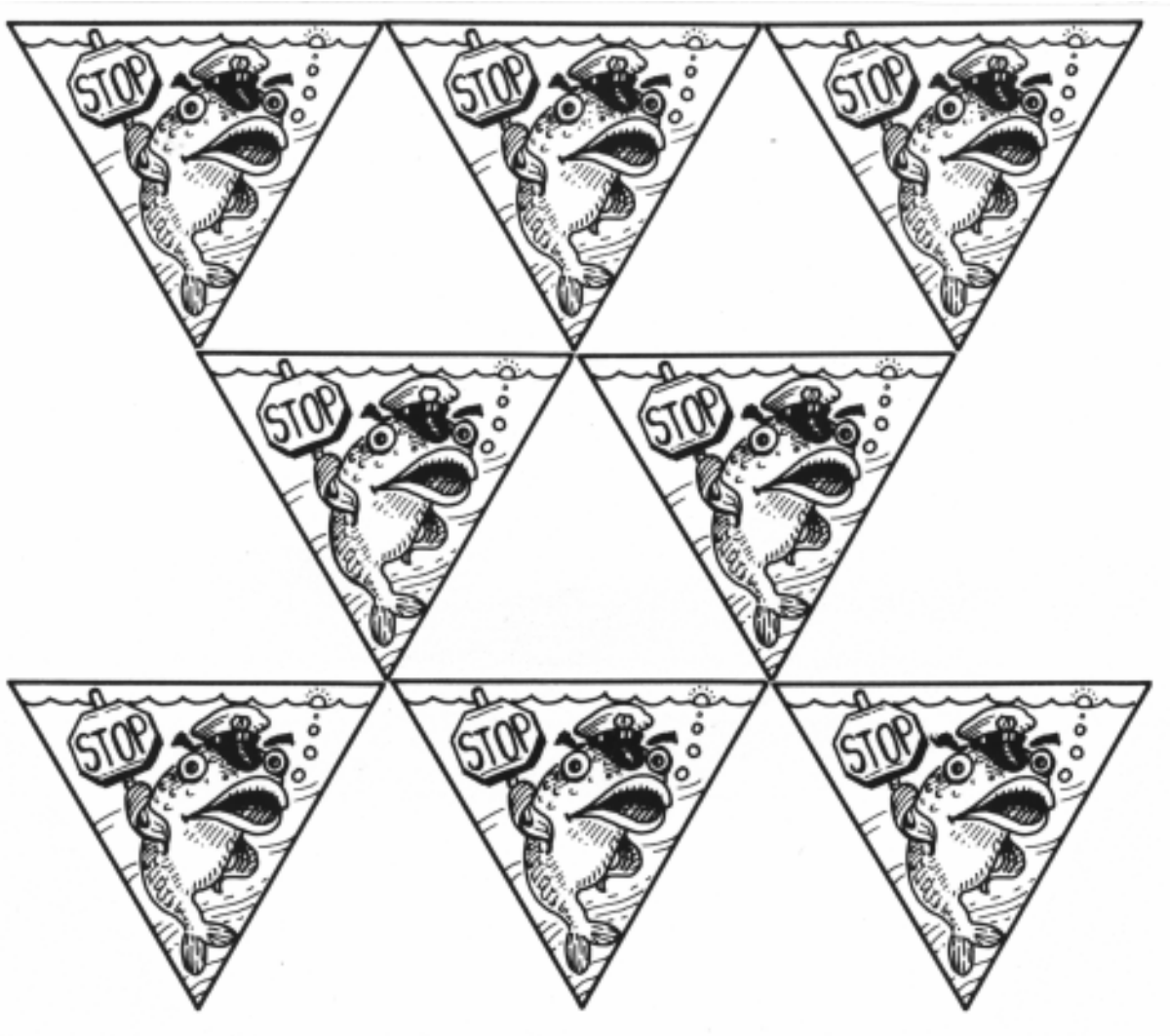
OVERBOARD

Recreational Uses of Water	Recreational Pollutants
Camping, Swimming, and Picnicking 	Litter (plastic bottles, cans, 6-pack rings, plastic bags, and pet waste) 
Houseboats 	Litter and Wastewater (human wastes) 
Boating, Boat Ramps, and Parking Lots 	Litter and Waste (fishing hooks, fishing line, oil, and gasoline) 
Gas Tanks and Pumps 	Oil and Gasoline 

POLLUTION PETE PATROL

Hi! I'm Pollution Pete! I'm here to help you stop Recreational Pollution!

Look at your recreation drawing and find the things that could cause pollution of your lake or river. Cut out my symbol and glue it beside the possible pollution sources.



RECREATIONAL POLLUTANTS DEMONSTRATION

1. Mix used coffee grounds with water and pour into a milk carton, filling it 1/3 to 1/2 full; it will still float. Poke a hole in the side of the carton with a pencil to insert the liquid soap pump into it. With the coffee grounds inside and the pump installed, float the "bilge model" in the aquarium. For each mention of the human waste pollutant sources, pump a small amount of the mixture into the water.

2. Pour a small amount of the vegetable oil into the plastic toy boat and float it in the aquarium. With each mention of oil and gas from boats, tip the boat and allow some "pollutant" to leak out.

3. Add other items as the listed pollutants are mentioned.

4. As more students reveal their possible sources of pollution, add more representatives of that pollution to the aquarium. Keep adding as many times as needed. Repetition will give a stronger impact.

What the laws say:

The Refuse Act of 1899 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, or any other liquid pollutants) into the waters of the U.S. The Federal Water Pollution Control Act prohibits the discharge of hazardous substances or oils into U.S. navigable waters. The MARPOL Annex V international law restricts overboard dumping of garbage. The U.S. law of Annex V prohibits the dumping of trash and limits the overboard dumping of other garbage.

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