WATER CHEMISTRY

OBJECTIVES

The student will do the following:

1. List reasons why water is important.
2. Investigate and graph the freezing points of different solutions.
3. Make flat models of water molecules.

SUBJECTS:
Science, Math

TIME:
90 minutes

MATERIALS:
3 clear plastic milk jugs
pitcher
cup of ice
water
salt
vinegar
measuring spoons
measuring cups
blue construction paper
red construction paper
scissors
hole punch
glue sticks
clear plastic cups (3 per team)
thermometers (1 per team)
masking tape
pencils
paper
graph paper

BACKGROUND INFORMATION

Water equals life. Where there is no water at all, there is no life and therefore water may be the most important substance on earth. Water is a colorless, odorless, tasteless substance. Each water molecule consists of one oxygen and two hydrogen atoms. In shape, a water molecule resembles a "Mickey Mouse" head. In its pure form, water is a good solvent, i.e., it can dissolve or mix with many substances. In fact, water has been called the "universal solvent" because of its ability to dissolve other substances. It is found everywhere and covers three-quarters of the planet. Water is found in our atmosphere, in our soil, and underneath the ground. The human body is about 75 percent water.

The total amount of water on earth stays the same, and the same water that exists now has always existed. Water can be found in all three states of matter (liquid, solid, and gas) on earth, most often in the liquid state. At 0°C (32°F) and normal atmospheric pressure, water freezes to form solid water (ice). At 100°C (212°F) and normal atmospheric pressure, water evaporates to form water vapor (steam).

Terms

freezing point: the temperature at which a substance begins to change from a liquid to a solid.

gas: a state of matter; a gas always has the same shape as the container it fills.

liquid: a state of matter; a liquid always has the same shape as its container.

solid: a state of matter; a solid generally has a shape of its own.

ADVANCE PREPARATION

A. Prepare the “mystery liquids” beforehand so they are ready for the activity. Use plastic milk jugs to prepare and store the liquids in.

   1. Liquid A is tap water.

   2. Liquid B is a 50/50 mixture of vinegar and water.

   3. Liquid C is salt water. Use 1 teaspoon (5 mL) of salt per cup (240 mL) of water.

B. Have on hand a pitcher of water, and a cup of ice.

C. Cut a large number of circles from blue construction paper. Cut twice as many smaller circles from red construction paper. (NOTE: You may use a hole punch to cut the red circles and make the blue circles about the size of a dime. Or, if you think it would be easier for students to work with larger pieces, use dimes to cut out the red pieces and quarters for the blue ones.)

D. Make arrangements to use the school kitchen’s freezer for about an hour.

PROCEDURE

I. Setting the stage

   A. Show the students a cup of ice and ask them to describe it.

   B. Fill the cup of ice with water from the pitcher. Discuss the fact that liquid water and ice are both water though they look and feel different.

   C. Take a sip of the ice water and discuss with the students that water is essential for life. Ask the students to list ways water can be used.

II. Activities

   A. Show the students the three liquids you have prepared.

      1. Ask them to compare them. Can they guess what they are?

      2. Tell the students what they are; explain that water can dissolve and/or mix with many substances.

      3. Have the students suggest other things that are soluble or miscible (mixable) with water.

      4. (Optional) Allow the students to test various substances’ solubilities or miscibilities. (Try sugar, cooking oil, rubbing alcohol, coins or other metal objects, and paper strips or other classroom items.)

   B. Divide the students into teams and have each team complete the following investigations:

      1. Give each team three cups and have them label the cups A, B, and C. Fill cup A one-third full with liquid A, cup B one-third full with liquid B, and cup C one-third full with liquid C. Give each team a thermometer.

2. Have the teams record the temperature of each liquid.

3. Choose one cup of each liquid (A,B,C) and put them (with thermometers in them) in the freezer. Have students record the temperatures every 15 minutes until all three are frozen. (Liquid A, tap water, will freeze first. The salt water in cup C will freeze next and the 50/50 mixture of vinegar and water in cup B will freeze last. This mixture is similar to the antifreeze solutions we use in automobiles.)

4. Have the students make a graph showing what happens to the temperature of each liquid.

5. Ask the students the following questions.

   a. How did the temperatures change? (gradually lowered until freezing took place)

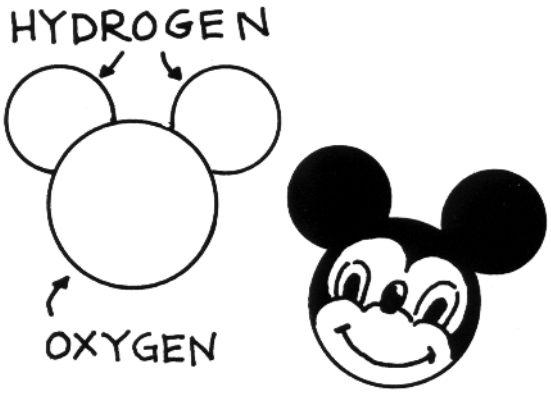
   b. At what temperature did each liquid freeze? (Results will vary somewhat, but the tap water should freeze at about 0°C.)

   c. Liquid A is water; B is water and vinegar; C is salt water. How do vinegar and salt affect the freezing temperature of water? (They lower it.)

   d. Antifreeze affects freezing temperature like salt in water. Why is it added to a car radiator in winter? (Antifreeze freezes at a lower temperature than water and when mixed with water prevents the water in the radiator from freezing.)

C. Introduce the students to water's chemical formula — H_2O. Explain that a glass of water has millions and millions of tiny water particles — the smallest possible water particles — called molecules.

1. Draw a large water molecule outline ("Mickey Mouse head") on the board. The "ears" are the two hydrogen atoms and the "face" is the oxygen atom. Relate this to the formula (H_2O).



2. Give each student a sheet of paper, a glue stick, and red and blue construction paper dots. Explain that the (smaller) red dots represent hydrogen atoms and the (larger) blue dots represent oxygen atoms. Tell them to imagine that the sheet of paper is a glass. They are to put water in the glass by gluing water molecules on the paper. Tell them to make "Mickey Mouse heads."

III. Follow-Up

A. Have the students write up the lab activity in the following form: problem, procedure, data, conclusions. In the conclusion, have the students propose reasons why the water freezes at different temperatures.

B. Have the students write the formula for water and draw a water molecule.

C. Have the students list three reasons water is important.

IV. Extensions

A. It has been proposed that icebergs in the Antarctic be towed to desert countries for use as drinking water. You can now buy bottled water from melted glacial ice in European countries. Discuss with the students the use of glaciers or icebergs as sources of water. What would be the advantages and disadvantages of such a use?

B. Have the students investigate how boiling temperatures vary with elevation.

RESOURCES

Elicle, C., "Water," Tennessee Conservationist Student Edition, January/February, 1988.

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

WATER, WATER EVERYWHERE!

OBJECTIVES

The student will do the following:

1. Illustrate the quantity and distribution of water on the earth.
2. Recognize the amounts of water used in daily activities such as bathing.
3. Compare the amounts of water used by different groups such as farming and manufacturing.

SUBJECTS:
Geography, Social Studies, Language Arts, Science

TIME:
50 minutes

MATERIALS:
large sheets of paper (construction, newsprint, or posterboard)
art supplies
index cards (optional)
paste or glue stick
globe or map of the world
hole punch
ring binders or yarn
teacher sheet (included)
gallon jug of water (optional)

BACKGROUND INFORMATION

Water is one of our most important resources. We use water to produce food, provide energy, and manufacture and transport goods. Water is also essential for the life of every organism on our planet.

Because water covers three-quarters of the earth's surface, it is easy to think of it as an endless resource. Of all water, more than 97 percent is found in the oceans as salt water. Of the remaining 3 percent that is fresh water, two-thirds is frozen in ice caps, glaciers, and on snowy mountain ranges. Only about one-half of one percent of all the water on the earth is usable fresh water. Of this amount, experts estimate that there is 30 to 50 times more water found in aquifers (underground), than in all the lakes, rivers, and streams on the surface. Most of the water we use (78 percent), however, comes from these surface waters.

We use fresh water for a variety of purposes. About 11 percent is used in urban and rural homes, offices, and hotels. Another 8 percent is used in manufacturing goods and mining. The production of electricity accounts for almost 39 percent of water usage, although using water to cool power plants and to turn turbines in hydroelectric power plants does not consume the water. The largest consumer of water is agriculture, which uses about 42 percent.

As individuals, we use large amounts of water. An average American uses around 150 gallons (over 570 L) a day. We are even composed of water; our bodies are about 75 percent water.

ADVANCE PREPARATION

A. Gather enough large sheets of paper and art supplies for students in teams of 2 or 3.

B. Copy teacher sheet "Water Fact Cards" and cut into individual cards. (NOTE: These would be more durable if pasted to 3 x 5 inch [7.5 x 12.5 cm] index cards or construction paper.)

PROCEDURE

I. Setting the stage

A. Show the class a globe or map of the world.

1. Ask students which there is more of: water or land? (water)

2. Explain that water covers more than three-fourths of the earth's surface.

B. Instruct the students to think of as many different uses of water as possible in three minutes.

1. Briefly review their answers, noting unique responses.

2. Explain that everyone uses water for a variety of purposes. Today's lesson will illustrate the quantity of water in the world and how much is used for different purposes.

II. Activity

A. Have the class construct a "Big Book."

1. Divide the students into teams of two or three.

2. Pass out art supplies and large sheets of paper or posterboard.

3. Distribute one "Water Fact" card to each group.

4. Instruct the students to use the information on the card to make an illustrated page for the classroom big book on water facts. Each page should have:

a. The fact given on the card

b. An illustration of the fact (NOTE: Remind students to think about symbols that would help illustrate their fact. For example, a salt shaker may be a good symbol for salt water, especially if it is filled to the level noted on the card.)

c. The names of the illustrators.

5. Monitor and make suggestions to each team as they work.

B. Upon the teams' completion of the pages, punch three or four holes on the left-hand side and connect them together with loose-leaf rings or yarn.

III. Follow-Up

A. Allow each group to read and share their page with the class. (NOTE: Provide students with a gallon [4 L] jug of water to compare the amounts given in the book.)

B. Have the students write other questions about water quantities they think would be interesting to know.

IV. Extensions

A. Have the students find answers to their water quantity questions from III. B.

B. Assign groups to design a bulletin board or door covering to present information out of their "Big Book."

C. Have the students make charts or graphs of all the different percentages out of the book.

D. Present copies of the book to other classes or to the school library.

RESOURCES

Debnam, Betty, "Treat Water Well" (from "The Mini-Page" educational activities), Knoxville News-Sentinel, October 30, 1990, p. B6.

Namowitz, S., and N. Spaulding, Earth Science, D.C. Heath and Company, Lexington, Massachusetts, 1989.

Pringle, L., Water: The Next Great Resource Battle, Macmillan Publishing, New York, 1982.

"Water: Essential to Life (1992 Utah's Young Artist's Water Education Classroom Calendar)," International Office for Water Education, Utah State University, Logan, Utah.

WATER FACT CARDS

Water Fact Three-fourths of the earth's surface is covered with water.	The largest user of water is agriculture, for growing crops and raising livestock. This uses 42% of our fresh water.
Water Fact 97% of our water is salt water found in the ocean.	**Water Fact** Our bodies are made of 75% water.
Water Fact While 3% of our water is fresh, 2% is trapped in ice caps, glaciers, and on snowy mountain ranges.	**Water Fact** It takes 1,400 gallons of water to produce a meal of a burger, fries, and a soft drink.
Water Fact Most of the fresh water we use comes from lakes, rivers, and streams (surface waters).	**Water Fact** The average American uses 150 gallons of water a day.
Water Fact There is about 40 times more fresh water in the ground than found in rivers, lakes, and streams.	**Water Fact** A person can use up to 50 gallons of water taking a bath.
Water Fact Homes, hotels, and offices use about 11% of our fresh water.	**Water Fact** For every inch of rain in a square mile, there will be more than 17 million gallons of water. (For every centimeter of rain in a square kilometer, there will be 10 million liters of water.)
Water Fact 8% of the fresh water we use goes to making goods and mining.	**Water Fact** A tree is 75% water.
Water Fact 39% of the fresh water we use helps us make electricity. **Water Fact**	**Water Fact** If you leave the water running while brushing your teeth, as much as 10 gallons (40 L) of water can go down the drain.
Complete a title page with the following: 1) A catchy title about water facts, 2) An illustration about water, 3) The name of the grade, school, and teacher working on the book.	**Title Page Group**

THE RETURNING RAINDROP

OBJECTIVES

The student will do the following:

1. Realize that water moves in a never-ending natural cycle.
2. Build a model of the water cycle in the form of a terrarium.
3. Explain how a terrarium demonstrates the water cycle.

SUBJECTS:
Science, Art, Social Studies

TIME:
90 minutes

MATERIALS:
2-liter clear plastic bottles with caps
potting soil
gravel
small plants or moss
tape
ruler
scissors (teacher use only)
student sheets (included)
crayons or colored markers (optional)
drawing paper (optional)
writing paper (optional)
ice cubes (optional)
heat source (optional)
beaker, jar, or saucepan (optional)
cookie sheet (optional)
sealable plastic bag (optional)
teacher sheet (included)

BACKGROUND INFORMATION

Water moves in a never-ending natural cycle, so the water you are using may have been a drink for some dinosaur! The forms of water are always changing. They move from sky to earth and back to the sky again. This is called the water cycle. Water falls to earth as rain or snow. Some of the water soaks into the ground and is stored as groundwater. The rest flows into streams, lakes, rivers, and oceans. The sun warms surface water and changes some of it into water vapor. This process is called evaporation. Plants give off water vapor too in a process called transpiration. The heated water vapor rises into the sky and forms clouds. When the vapor in the clouds condenses, it falls back to the earth as rain or snow. The water cycle has then come full circle and begins again.

Terms

condensation: the change of water from a gas to a liquid.

evaporation: the process of converting or changing into a vapor.

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

water: a resource needed by all living things in an ecosystem.

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

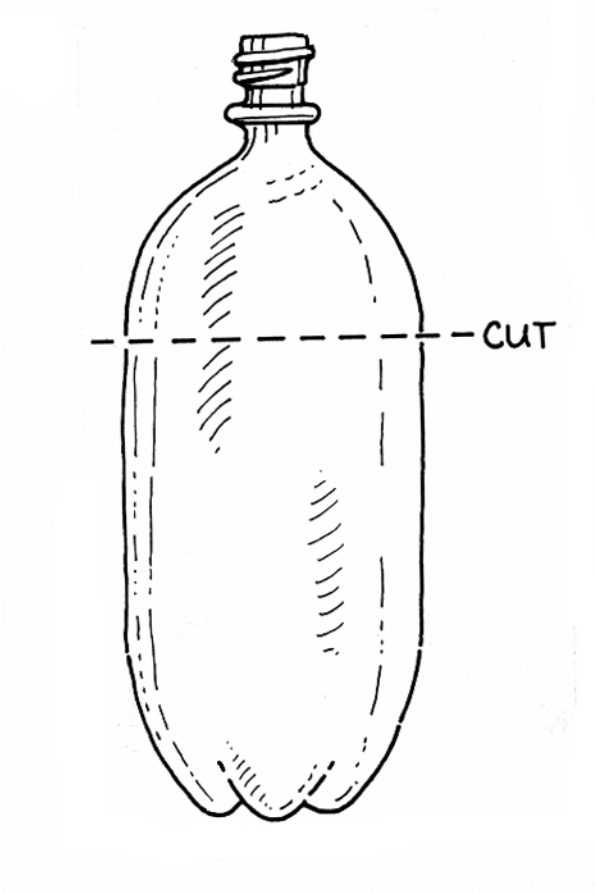
water vapor: the gaseous state of water.

ADVANCE PREPARATION

A. Gather the materials for the terrarium(s). (NOTE: One terrarium can be made for a class demonstration or each student or team of students can make one. Materials for each terrarium include: a 2 liter clear plastic bottle, 2 inches (5 cm) of potting soil, small plants (moss works great), 1/2 inch (1.25 cm) of gravel, and tape.

B. Cut bottle(s) ahead of time. (NOTE: Scissors easily and evenly cut the plastic bottles.)

C. Make copies of each of the two student sheets for each student's use in follow-up exercises.



PROCEDURE

I. Setting the stage

A. Have the students name all the ways they use water in a day. Encourage them to include ways that water is used indirectly (e.g., food preparation, manufacturing, farming, etc.).

B. Tell the students the same water they are using today has been on earth from its beginning. It is recycled continuously in the water cycle.

II. Activity

A. Introduce and explain the new terms using the chalkboard (evaporation, water vapor, condensation, precipitation, water cycle). Give everyday examples of each term.

1. Condensation - water droplets on the outside of a cold soda can

2. Precipitation - snow, rain, sleet, hail

3. Evaporation - dew disappearing from the grass

4. Water vapor - steam rising from a boiling pan of water

5. Water cycle - snowfall or puddles appearing and disappearing (The technical term is the "hydrologic cycle." If your students enjoy "big" words, introduce this term and discuss with them the "hydro-" root word.)

B. So that students may observe the water cycle, build a terrarium (or have students or teams build their own). (NOTE: See teacher sheet, "Terrarium Concept.")

1. Place 1/2 inch (1.25 cm) of gravel in the bottom of the bottle. (This is for drainage.)

2. Cover the gravel with about 2 inches (5 cm) of rich potting soil.

3. Plant the small plants or moss you have gathered.

4. Gently water the soil until moist.

5. Place the top back on the bottle and tape securely in place.

6. Place in a well lighted – but not too sunny – area. If all goes well, the plants will thrive and the water cycle can be observed all year.

C. Together with the students, observe the container after 24 hours. Note all changes and discuss the water droplets on the inside of the terrarium(s).

D. Ask the students how this demonstrates the water cycle.

E. Ask the students where the droplets come from and where they go.

III. Follow-Up

A. Have the students complete the water cycle student sheet, "The Returning Raindrop." List the terms on the board. (NOTE: They may color the picture when they are finished.) (Answers: 1. evaporation, 2. condensation, 3. precipitation, 4. water cycle.)

B. Have the students draw a representation of the water cycle demonstrated in the terrarium. (See the teacher sheet.)

C. Relate the water cycle to lakes, rivers, or other water sources in your immediate area.

D. Have the students complete the water cycle term sheet, "Water Cycle Matching." (Answers: 1A, 2D, 3E, 4B, 5C, 6F, 7G.)

IV. Extensions

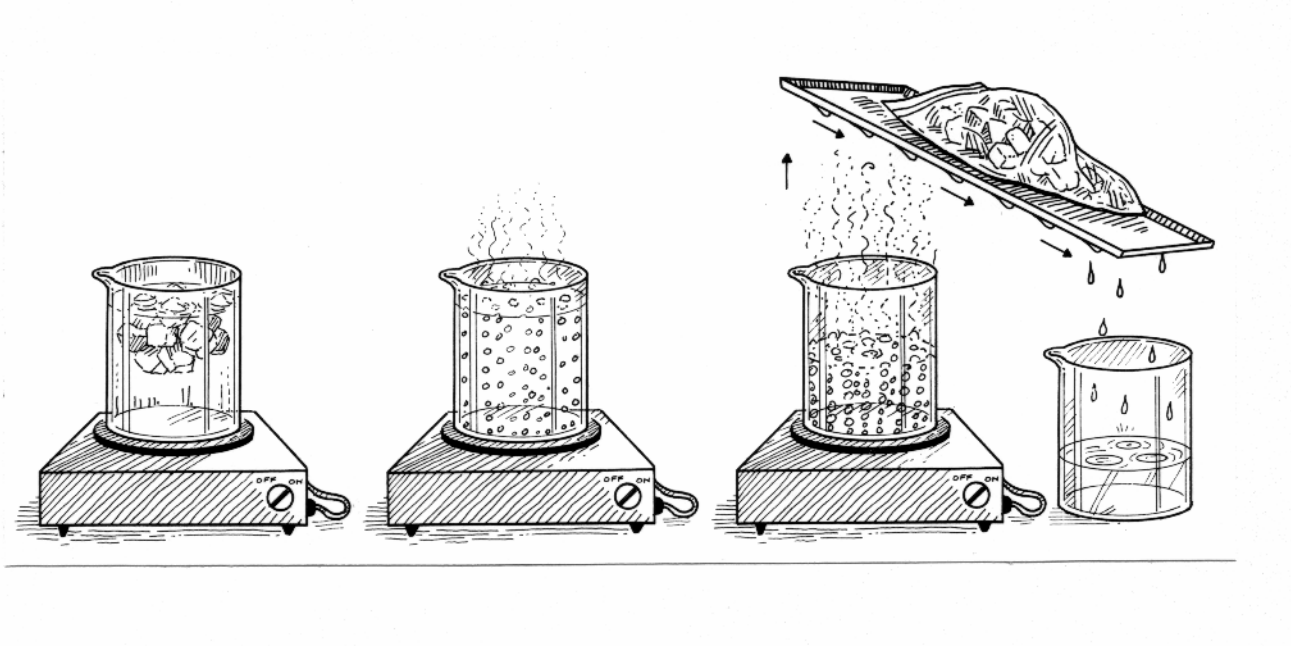
A. Discuss ways that water supplies become polluted and the water quality declines.

B. Have the students write a story about being a raindrop and traveling through the water cycle.

C. Demonstrate the three forms of water (solid, liquid, gas) as depicted below.

1. Ice cube - solid
2. Liquid - melted ice cube
3. Gas - evaporated water from melted ice cube.

RESOURCES



The Energy Sourcebook: Grades 3-5 Unit, Tennessee Valley Authority, 1990.

Hackett, Jay K., Science in Your World (Grade 3), Macmillan McGraw-Hill, New York, 1991.

"The Story of Drinking Water," American Water Works Association, Denver, Colorado, 1984.

TVA: A World of Resources, Tennessee Valley Authority, 1986.

"Water Fun," Los Angeles Department of Water and Power, Los Angeles, California, 1984.

Student Sheet

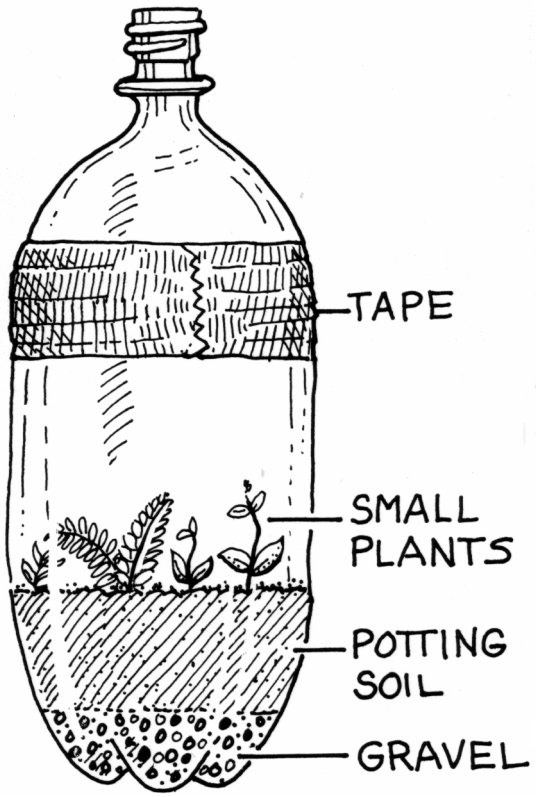
TERRARIUM CONCEPT

A terrarium is a simple and effective way for your class to watch the water cycle operating on a small scale. The plants take up moisture from the soil and release it through their leaves. The water molecules later condense on the inside of the plastic bottle and “rain” back to the soil. You never need to add water to the terrarium as long as it stays closed.

This classroom water cycle works in miniature much the same way the water cycle works on a large scale for our planet. It is also a good introduction to the concept of ecological cycles.

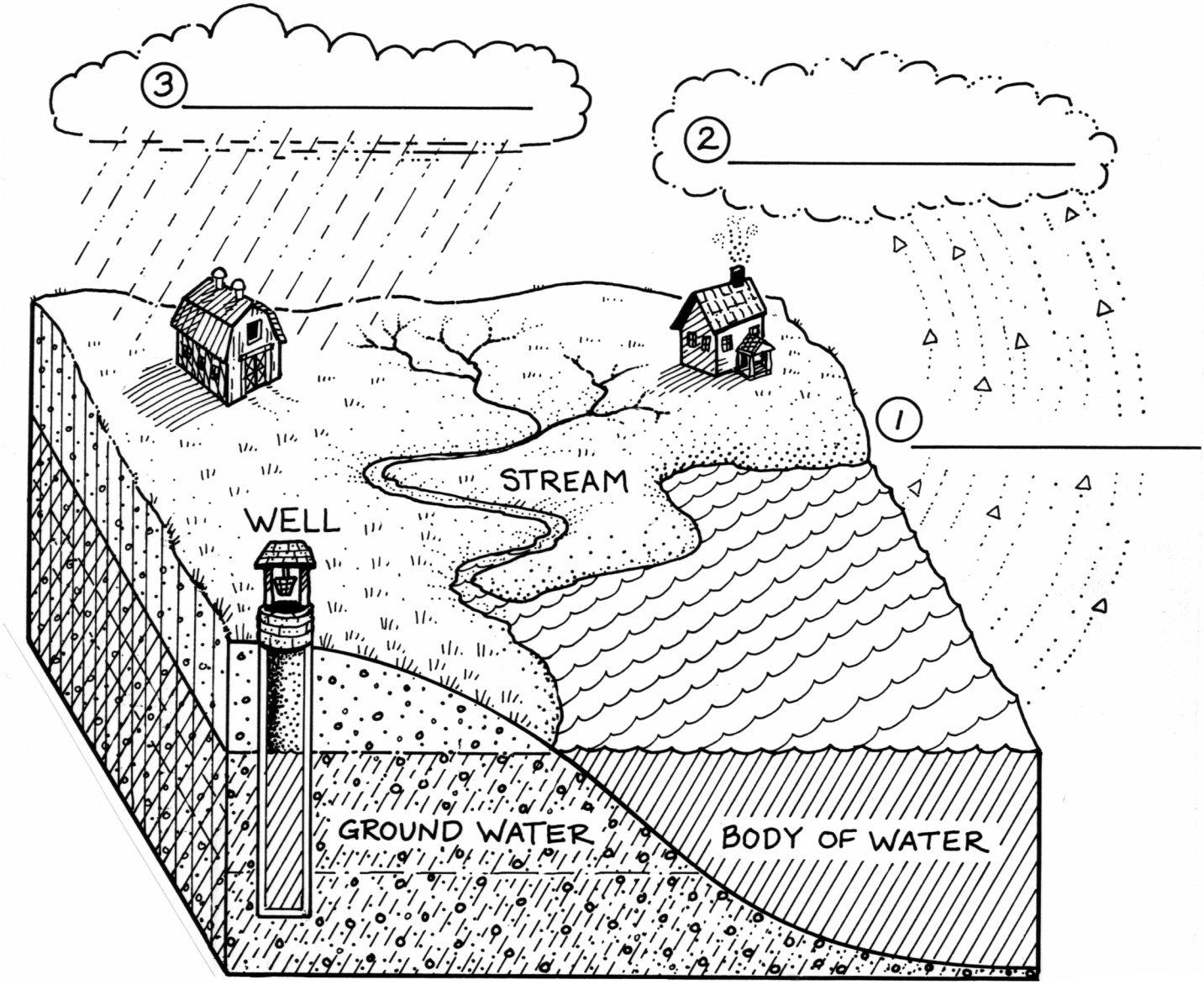
The students can present terrariums as gifts to their parents. You might ask parents to donate some small plant cuttings as well as other supplies needed.

The terrariums are easily assembled, but be sure to cut the plastic bottles before starting the students on the assembly.



THE RETURNING RAINDROP

Fill in the blanks to label the picture. Use the terms at the bottom.



Terms: water cycle
evaporation
condensation
precipitation

Student Sheet

WATER CYCLE MATCHING

Match the definitions with the terms in the word bank below. Put the letter of the term in the blank.

____1. The change of water from a gas to a liquid.

____2. The process in which water becomes a vapor in the atmosphere.

____3. The method in which water continually moves from the earth to the atmosphere and back again.

____4. A resource needed by all the living things in an ecosystem.

____5. The gaseous state of water.

____6. The forms of condensed water vapor such as snow, rain or sleet.

____7. Water stored in the ground.

Word Bank:

A. Condensation

B. Water

C. Water vapor

D. Evaporation

E. Water cycle

F. Precipitation

G. Groundwater

WATER ALL OVER THE WORLD

OBJECTIVES

The student will do the following:

1. Discuss why water is an important natural resource.
2. Observe how much of the earth's surface is covered by water.
3. Remove salt from water.

SUBJECTS:
Science, Social Studies, Language Arts, Geography

TIME:
60 - 90 minutes

MATERIALS:
dinner plate
saucer
glass bowl
table salt
water
old magazines
glue sticks
scissors
paper
globe or world map
paper clips
heavy black marker
student sheet (included)
teacher sheet (included)

BACKGROUND INFORMATION

Living things always need water. Water covers about three-quarters of the earth's surface. It can be found in the earth's oceans, lakes, streams, and other bodies of water, as well as ice, in the atmosphere, and underground. Water is used over and over again.

Water found in water bodies on the earth's surface is called surface water. Most surface water is salt water. Plants and animals that live on land or in fresh water cannot use salt water unless the salt is removed from it. The process of removing salt from salt water is called desalination.

Terms

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

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, and reservoirs.

ADVANCE PREPARATION

A. Gather the materials.

B. Copy the student sheet for distribution.

PROCEDURE

I. Setting the stage

A. Using a globe or a world map, ask the students to describe the earth's surface. Have them identify the large land masses and bodies of water.

B. Ask the students what other bodies of water they can see.

C. Have students estimate about how much of the earth's surface is covered by water. (about three fourths)

II. Activity

A. Tell the students that water is a natural resource all living things must have. In some places there is not enough fresh water and the only water is salty ocean water. The people who live in those places must find ways to take the salt out of the water before using it. This is called desalination. Desalination is done in large plants (like factories). We will make a model of a desalination plant.

1. Make salt water by dissolving about 2 teaspoons (10 mL) of table salt in one cup (250 mL) of water.

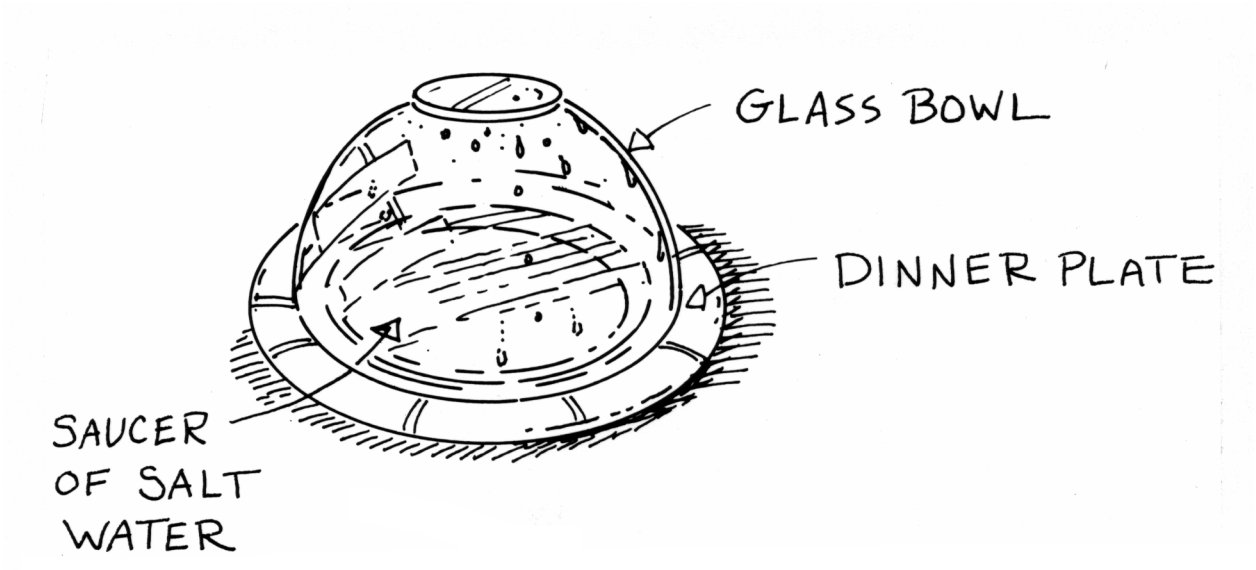
2. Get a dinner plate, a saucer, and a clear glass bowl that is wider than the saucer.

3. Put the saucer on the dinner plate.

4. Fill the saucer with salt water.

5. Place the glass bowl down over the saucer.

6. Put this apparatus outside in a sunny place. After a time, the students should see small drops of water on the inside of the bowl. On a very warm, sunny day this will happen quickly.



B. Ask the students to address the following items after you are able to observe drops:

1. Describe what you would do to find out if the drops of water inside the bowl are fresh water or salt water. (They should be able to identify tasting as the simplest way to determine this, but discuss with them that unless they are specifically directed to taste something in an experiment, they should never do so.)

2. Describe what you would do to collect the drops of water that form inside the bowl.

3. Describe problems that might occur when water is being desalted.

C. Discuss again with the students how much more salt water there is than fresh water. Have them state why desalting water might be very important to people.

D. Ask the students what caused the water to evaporate in the model. (the sunshine's warmth or solar energy) Remind them that energy is always required by any process that changes matter. While solar energy is free, other forms of energy are not; people who use these energy resources must pay for them. Because of the large energy requirements of the desalination facilities, desalted ocean water is expensive. In places in the world that have very little fresh water (but lots of ocean water), people pay much more for their water. Ask the students how this might affect how people use water. (This would cause them to use water more carefully and less wastefully.)

III. Follow-Up

Give the students old magazines, paper, scissors, and glue sticks. Have them cut out pictures that show how water is used. Have them use the pictures to make collages of how water is used.

IV. Extensions

A. Have the students design and conduct experiments investigating desalination. For example, will the model work in a dark place, or how could the model be improved?

B. Have students write a poem based on a "water word." See the teacher sheet, "Water Word Poetry" (included).

1. List several water words on the board. Use descriptive words or geographic terms.

2. Have students brainstorm a list of words that describe or are related to each "water word." Put lists on the board under the appropriate words.

3. Explain how to write a shape poem and an alphabet poem. Put examples on the board.

4. Instruct students to choose one of these forms and one of the water words for the subject of their poem. Use the other words to construct the poem.

5. Display the poems in a prominent location.

C. Have the students complete the student sheet "Geographic Water Terms." This is a good activity for cooperative learning groups. The answers for the matching exercise are: 1-H, 2-C, 3-E, 4-I, 5-B, 6-J, 7-A, 8-F, 9-D, 10-G.

RESOURCE

Mallinson, G. and J. B. Mallinson, Science Horizons, Silver Burdett & Ginn, Morristown, New Jersey, 1989.
Teacher Sheet

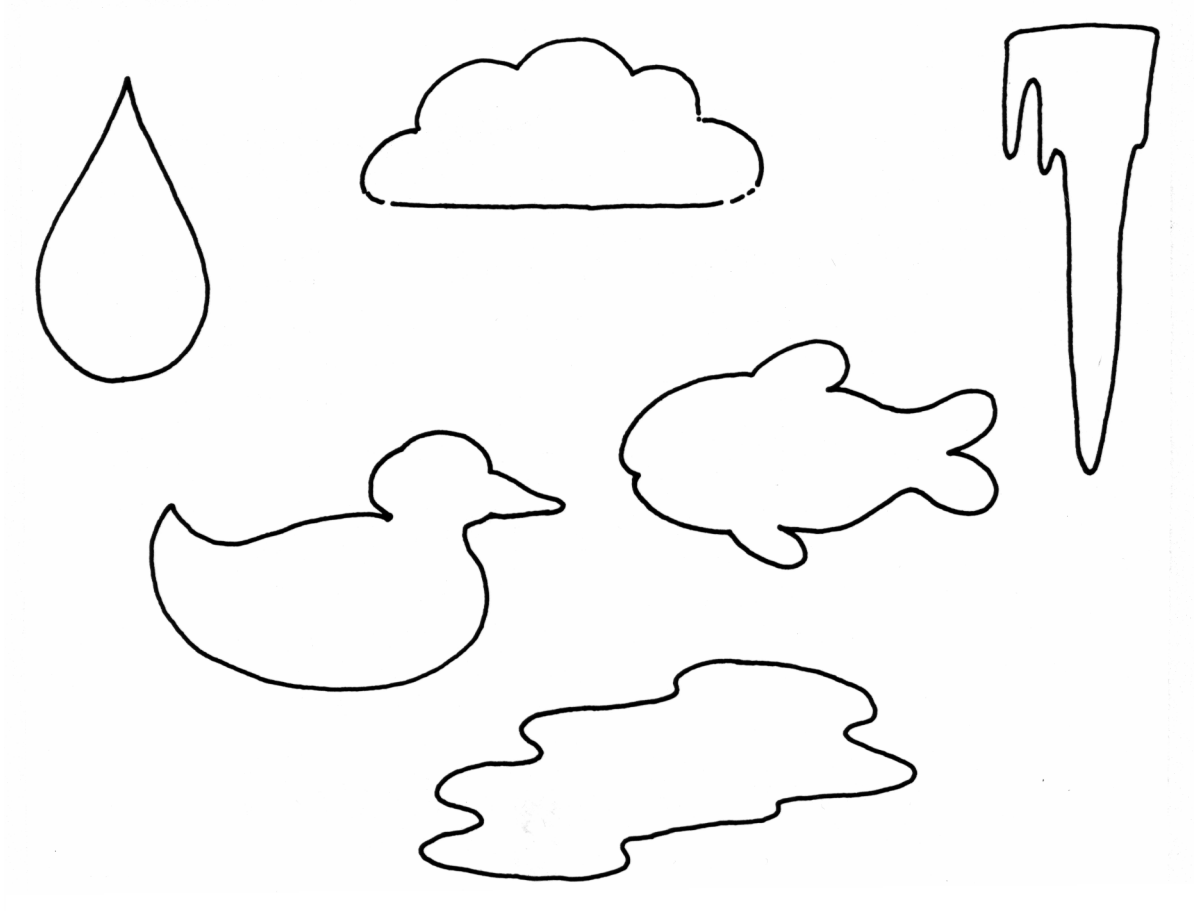
WATER WORD POETRY

Alphabet Poems: Use a "Water Word" to construct an alphabet poem. The related word or describing word must begin with a letter corresponding to one of those in the water word.

Ex.	W	inding
	A	round
	T	hrough
	E	arth
	R	eservoirs

Shape Poems: With a heavy black marker, draw a large simple shape (such as a water droplet). Place a sheet of paper over the pattern and clip it in place. <u>After constructing the water word poem</u>, rewrite it in the shape of the water droplet (or another appropriate shape).

Student Sheet



GEOGRAPHIC WATER TERMS

Match the terms with their definitions. Use a globe or a world map to help you determine the answers.

____ 1. Bay

____ 2. Harbor

____ 3. Ocean

____ 4. Port

____ 5. Peninsula

____ 6. Lake

____ 7. River

____ 8. Gulf

____ 9. Island

____10. Coast

A. A large stream of water that flows across the land and usually empties into a lake, an ocean, or another river.

B. Land with water around it on three out of four sides..

C. A protected place where ships are safe from the ocean's waves.

D. A body of land entirely surrounded by water.

E. The largest body of water.

F. A large body of water that reaches into the land.

G. The land along a sea or ocean.

H. A small body of water reaching into the land.

I. A place where ships load and unload goods.

J. A body of water entirely surrounded by land.

Now use each term in a sentence. To be sure you have used them correctly, check the definitions in a dictionary. Rewrite any sentences you need to improve.

1. Bay _____

2. Harbor _____

3. Ocean _____

4. Port _____

5. Peninsula _____

6. Lake _____

7. River _____

8. Gulf _____

9. Island _____

10. Coast _____

LET'S GO DOWN UNDER!

OBJECTIVES

The student will do the following:

1. Define appropriate groundwater terms.
2. Explain where groundwater is found.
3. List the steps of the water cycle in correct sequence.
4. Identify sources of groundwater pollution and possible solutions.

SUBJECTS:
Science, Language Arts

TIME:
90 minutes

MATERIALS:
student sheets (included)
index cards
clear plastic sweater box or similar container
posterboard
string or fishing line
colored markers
clay
soil
sand
gravel
plastic sandwich bag
small plastic bowl
grass
plastic tree figures
water
teacher sheet (included)
materials to make puppets (optional)
posterboard and art supplies (optional)

BACKGROUND INFORMATION

Every day, people all over the world depend on a hidden resource—groundwater. Only 3 percent of the earth's water supply is fresh water and almost 2 percent of that is groundwater. In fact, more than 50 percent of the people in the United States get their drinking water from groundwater, including almost all who live in rural areas.

There is really nothing mysterious about groundwater. We just can't see it like we can see a pond, a stream, or the ocean. This water collects below the earth's surface in aquifers, spaces between soil and rock particles. It is also found in cracks and crevices and inside porous rocks.

The top surface of groundwater is called the water table. When the water table is high enough, groundwater comes to the surface naturally in springs, lakes, ponds and rivers, and it can also be brought to the surface by drilling wells. But the top level of the groundwater (the water table) is usually underground. Groundwater is a vital part of the water cycle and is replenished by rainfall. The amounts of groundwater in different areas of the world vary, and the amount at any one place can change due to prolonged drought, heavy withdrawal for human use, or other factors..

Groundwater quality is generally better than that of surface water because it is not as readily exposed to pollution sources. Also, the movement of groundwater through various layers of soil and rock filters out many impurities. However, some groundwater can be polluted by pesticides, chemicals, landfill leachate, and other materials that seep into groundwater supplies.

<u>Terms</u>

aquifer: an underground layer of unconsolidated rock or soil that is saturated with usable amounts of water (a zone of saturation).

filter: to remove contaminants by using a porous material such as paper or sand.

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.

impurities: substances that make another substance unclean.

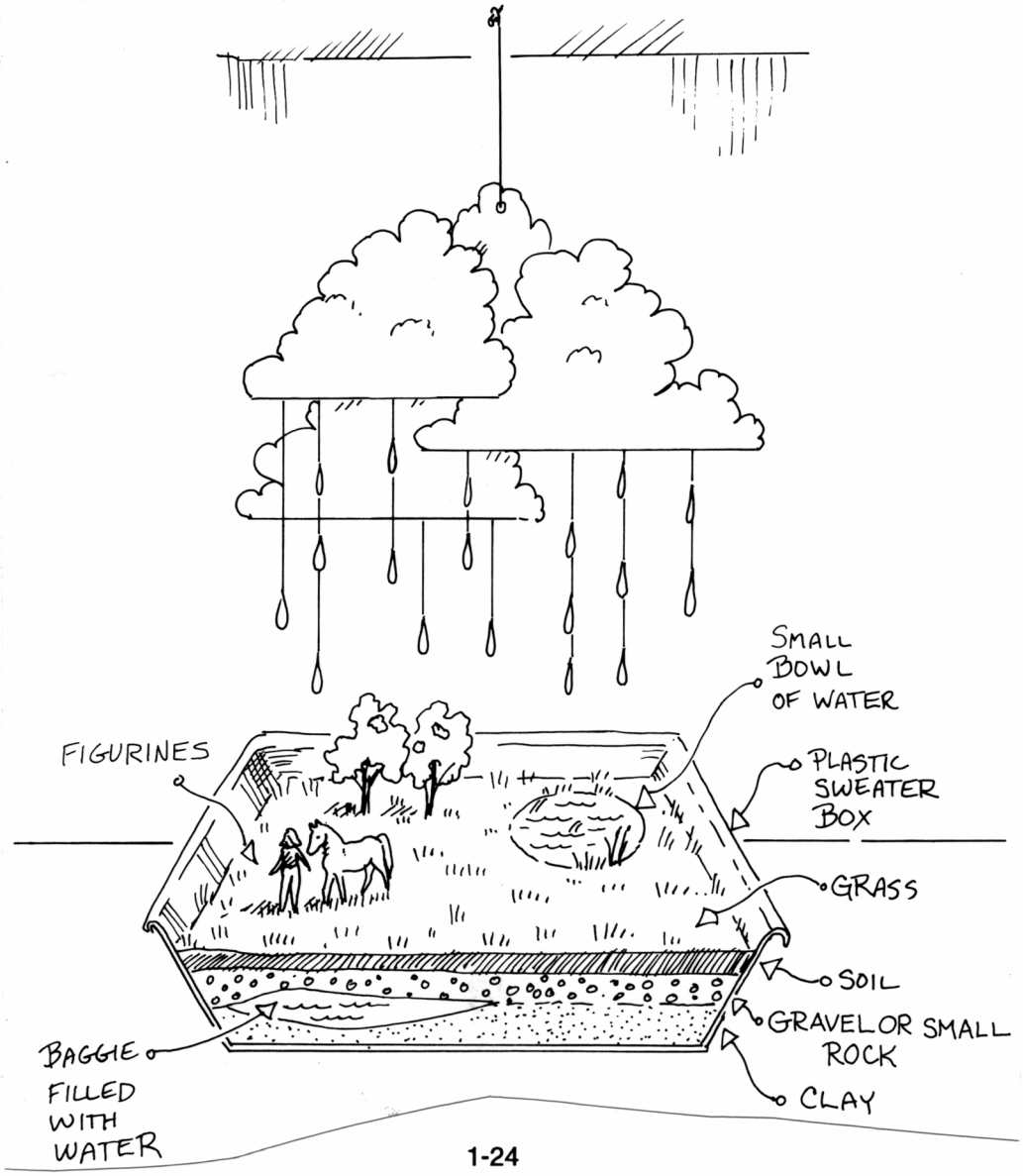
pollution: contaminants in the air, water, or soil that cause harm to human health or the environment.

porous: having pores or cavities that can hold substances such as water.

source: where something originates.

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

water table: the upper surface of the zone of saturation of groundwater.



ADVANCE PREPARATION

A. Construct model of water cycle. Use posterboard to make clouds and raindrops. Hang clouds with raindrops below them (use string or fishing line). In a clear container, such as a plastic sweater box, create "the ground" area. From the bottom up, layer the following: clay, gravel or small rock, a plastic sandwich bag filled with water, layer of soil, small plastic bowl filled with water (sink the bowl into the soil so the top will be at surface level to simulate a pond or lake), grass, trees, and other figures.

B. Photocopy and cut out 5-6 sets of game cards for "Pollution Solution" (similar to "Old Maid"). Glue the game cards to index cards for durability and uniformity.

C. Photocopy the student sheets, "What's Wrong With This Picture?," "The Water Cycle," and "Groundwater: Fact or Opinion?"

PROCEDURE

I. Setting the stage

A. Pour a small amount of water into the water cycle model. Ask students where the water went. Explain that since it soaked into the ground and will seep into underlying rock formations, it is called groundwater.

B. Explain that the top surface of the groundwater is called the water table.

C. Ask students which they think would be most easily polluted: surface water (lakes, ponds, etc.) or groundwater. Ask them to give reasons for their answers.

D. Point out the importance of groundwater as a part of the water cycle.

II. Activities

A. Discuss the steps in the water cycle. Refer to the model.

1. Distribute the student sheet "The Water Cycle." You may want to have the students do this in small groups or you may do this together, as a class.

2. Students number the steps in the water cycle in the correct sequence, beginning and ending with evaporation. (Answer: 4,3,6,5,2,1)

3. After students complete the activity, list the steps on the board as they call them out.

B. Divide students into 5-6 groups (of no more than 5) to play the card game, "Pollution Solution," which is similar to "Old Maid."

1. Hand out a card set to each group.

2. Explain that for each pollution card there is a corresponding solution card. After all the cards are dealt, students take turns laying down pairs of cards. If a student does not have a pair, he/she must draw a card from the person who played just before him. He then lays down cards if he makes a match, and it is the next person's turn. At the end, whoever is left with the "Groundwater Gobbler" loses.

C. Have the students do the “What’s Wrong With This Picture?” worksheet. You might prefer to do this together as a class using the student sheet master to make a transparency. The illustration shows at least 17 possible sources of groundwater pollution. See the teacher key. (Have the students name at least 10 of these.)

III. Follow-Up

A. Have students complete the student worksheet called “Groundwater: Fact or Opinion?” (Answers: 1.0, 2.F, 3.0, 4.0, 5.F, 6.F, 7.0, 8.F, 9.0, 10.0)

B. Review with students the many sources of groundwater pollution. Summarize that anything that pollutes water can pollute groundwater, especially things stored on or under the ground or applied to it. Ask them to make a list of what they and their families can do to help keep groundwater clean.

IV. Extensions

A. After reviewing correct letter form, have students write to the American Ground Water Trust (and other sources) for additional information.

B. Have students make posters to display around the school using the information from III. B.

C. Have students write and direct a puppet show on pollution and its consequences and present it to another class.

RESOURCES

“America’s Priceless Groundwater Resource,” American Ground Water Trust, Dublin, Ohio, 1991.

“Groundwater Pollution Control,” American Ground Water Trust, Dublin, Ohio, 1990.

THE WATER CYCLE

Number the steps in the water cycle in the correct sequence, beginning and ending with evaporation.

_____ Replenishes (recharges) water in rivers, lakes, streams, and ponds

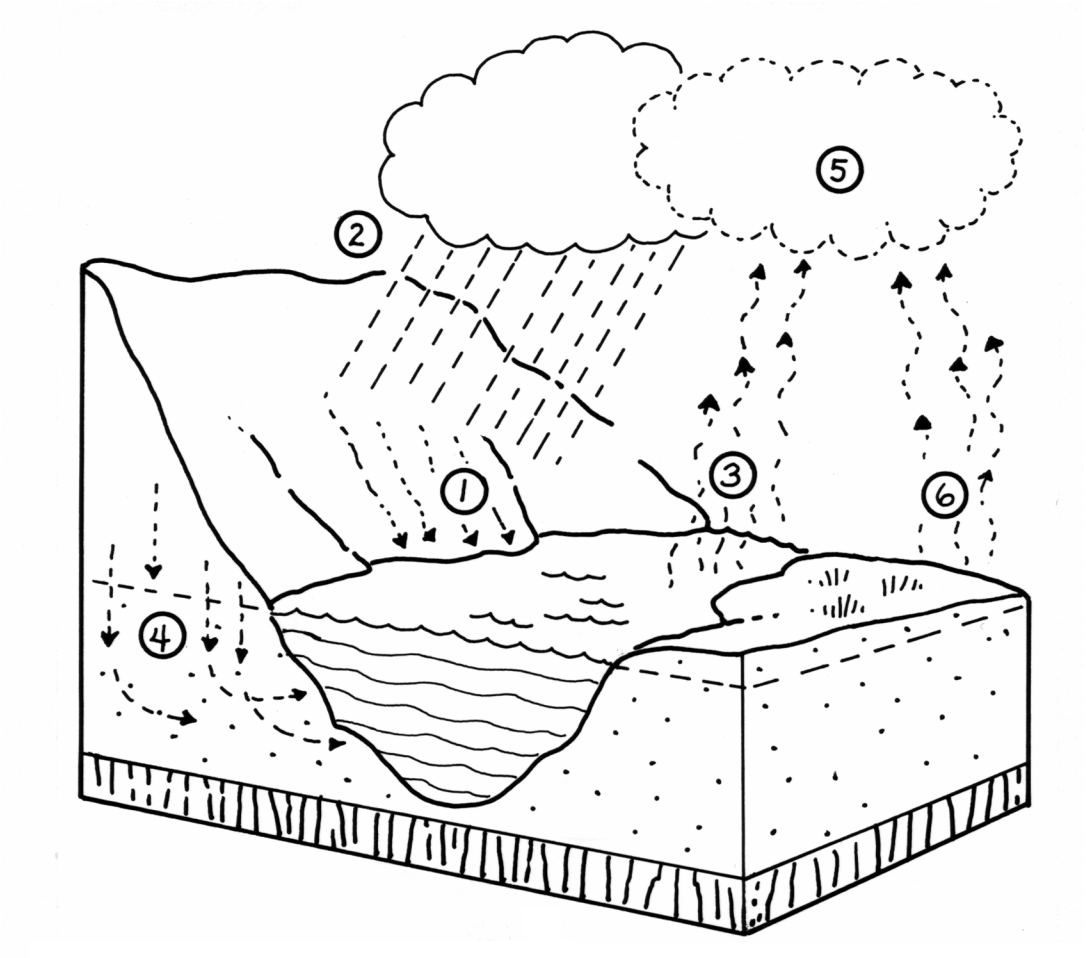
_____ Falls to the earth in some form of precipitation (rain, snow)

_____ Surface water evaporates again

_____ Seeps into the ground and enters an aquifer

_____ Condenses in the atmosphere

_____ Evaporates from surface water, plants, and animals as water vapor



"POLLUTION SOLUTION" GAME CARDS

S Require that people disposing of manure, garbage, or industrial wastes get permission from the government or make laws to control where they can dispose of them	S Make underground storage tanks from something other than metal (it can get rusty and get holes) and check how much is put in and taken out (to see if anything is "missing")
S Make laws to control how facilities to handle human waste are built and installed and to limit the number of them in an area	S Using only the amount of fertilizer and pesticide that is really needed, and making laws to control how they can be thrown away
S Build the cattle or hog feedlots and the chicken houses so that rain will not wash animal wastes into streams or ponds	P Fertilizers and pesticides put on farmlands or yards to help crops or yards grow and be healthy
P Holding ponds and lagoons used to hold liquid wastes or wastes mixed with water	P Human waste leaking from septic tanks, cesspools, or privies
P Improper disposal of waste such as manure, garbage, or industrial wastes	S Checking pipes to make sure they are working properly and not leaking
P Slimy liquid from garbage (leachate) leaking out of landfills	P Animal wastes produced in large amounts at places where many cattle, hogs, or chickens are kept
S Don't allow holding ponds or lagoons unless they are leakproof	P Leaks from underground storage tanks that hold gas or oil
S Locating landfills in places that are less likely to let the leachate reach groundwater	S Cover the piles of road salt with plastic or put it in sheds
P Piles of road salt stored until it is needed in winter	P Leaks in big pipes that carry oil, gas, or wastes
GROUNDWATER GOBBLER	

GROUNDWATER: FACT OR OPINION?

If the statement is a fact, put an F on the line. If it is an opinion, put an O.

_____ 1. Groundwater is a mysterious source of water.

_____ 2. Groundwater is found beneath the earth's surface.

_____ 3. Groundwater tastes better than surface water.

_____ 4. Groundwater is the most important of all natural resources.

_____ 5. Groundwater is not as easily polluted as surface water.

_____ 6. Groundwater is a part of the water cycle.

_____ 7. Studying about groundwater is boring.

_____ 8. One person's actions can affect groundwater.

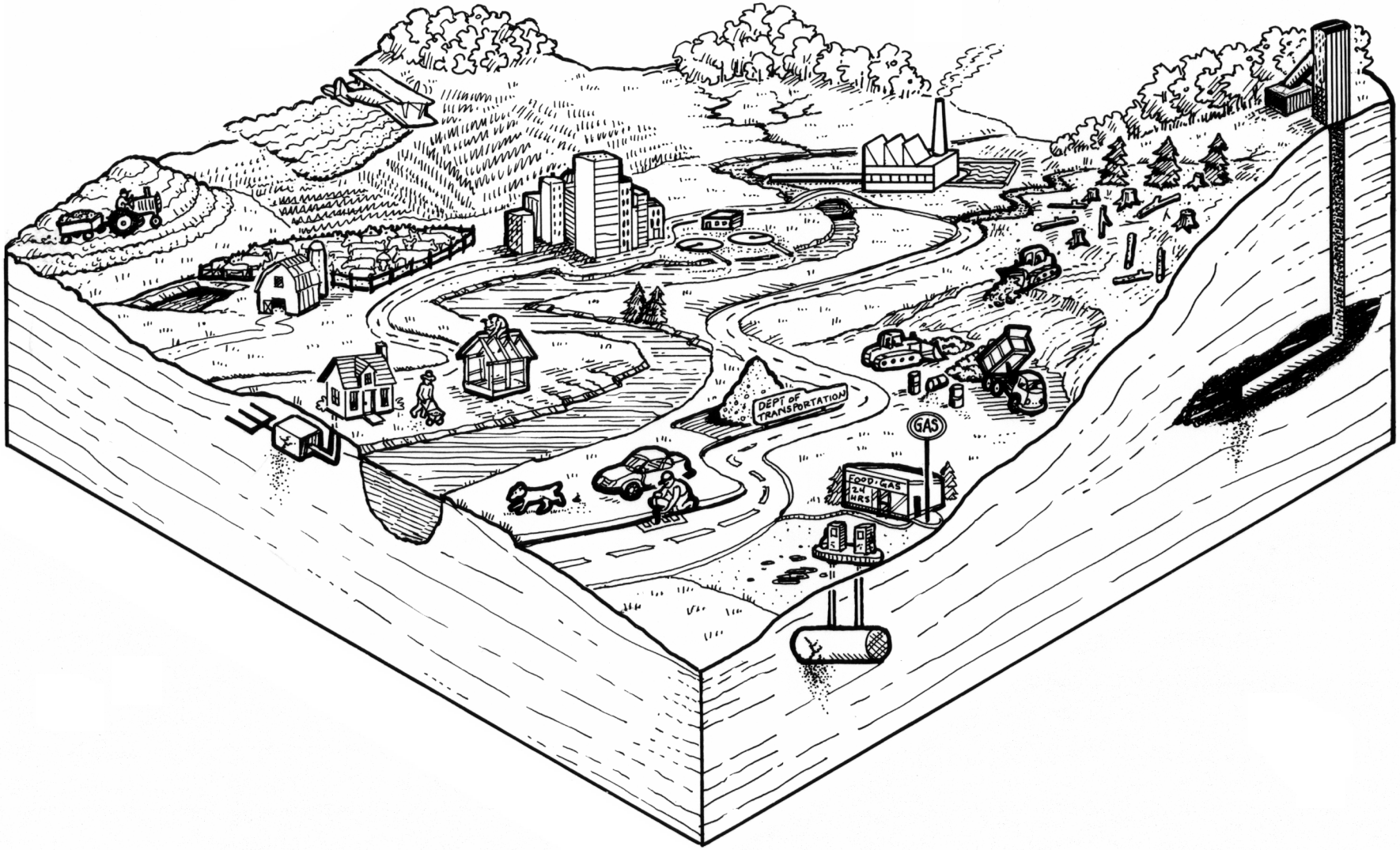
_____ 9. Landfills are yukky.

_____ 10. Farmers should not use pesticides.

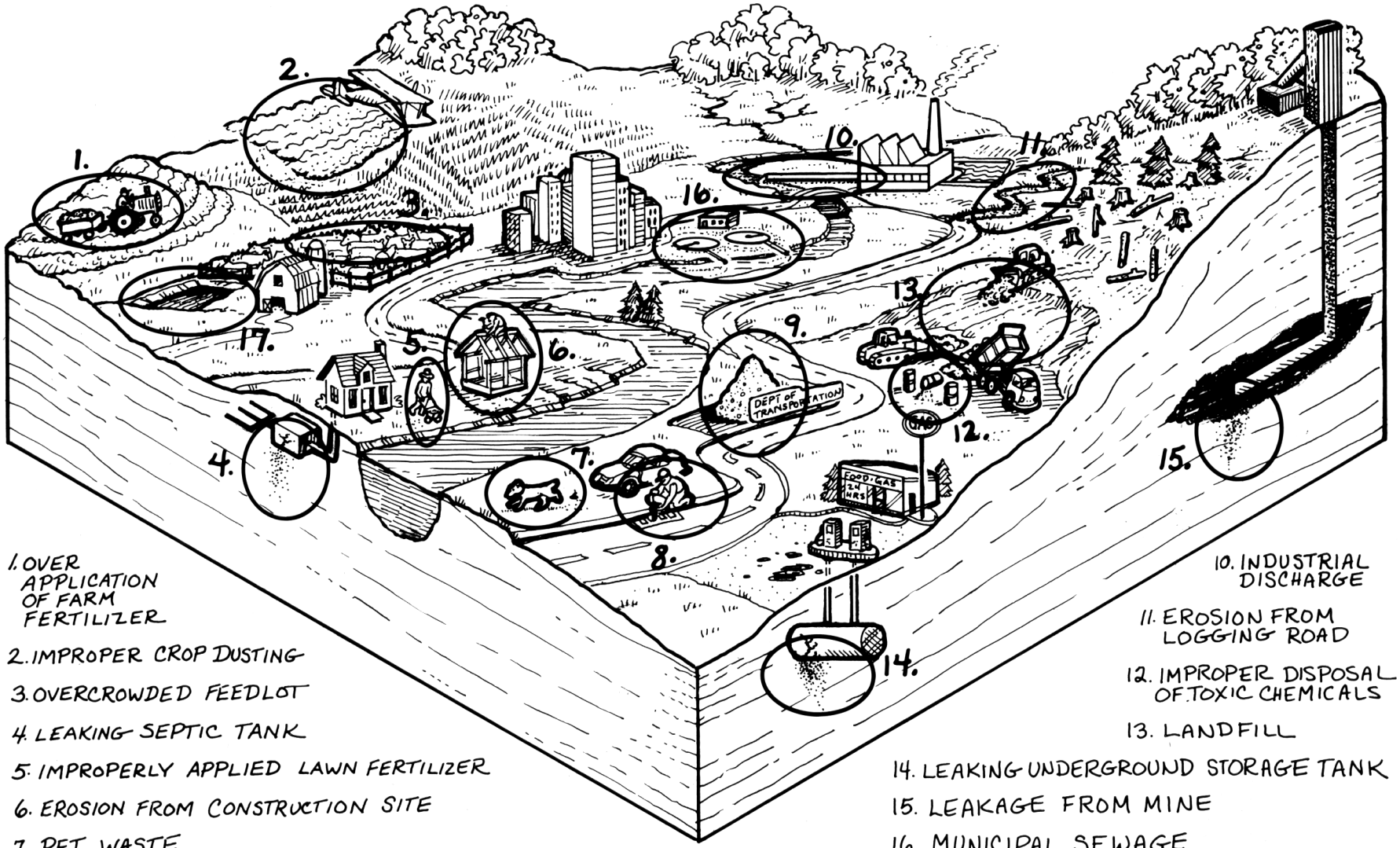
WHAT'S WRONG WITH THIS PICTURE?

Student Sheet

There are 13 potential sources of water pollution in this diagram. Circle them and label each one.



WHAT'S WRONG WITH THIS PICTURE? TEACHER KEY



1. OVER APPLICATION OF FARM FERTILIZER
2. IMPROPER CROP DUSTING
3. OVERCROWDED FEEDLOT
4. LEAKING SEPTIC TANK
5. IMPROPERLY APPLIED LAWN FERTILIZER
6. EROSION FROM CONSTRUCTION SITE
7. PET WASTE
8. IMPROPER DISPOSAL OF MOTOR OIL
9. ROAD SALT
10. INDUSTRIAL DISCHARGE
11. EROSION FROM LOGGING ROAD
12. IMPROPER DISPOSAL OF TOXIC CHEMICALS
13. LANDFILL
14. LEAKING UNDERGROUND STORAGE TANK
15. LEAKAGE FROM MINE
16. MUNICIPAL SEWAGE
17. LEAKING ANIMAL WASTE STORAGE LAGOON

BY THE SEA

OBJECTIVES

The student will do the following:

1. Define coastal waters.
2. Locate coastal waters on a map.
3. Label coastal waters on a map.

SUBJECTS:
Social Studies, Science

TIME:
90 minutes

MATERIALS:
globe or world map
teacher sheets (included)
acetate sheets
overhead projector
student sheet (included)
crayons or highlighters (one per student)
transparency pen (wipe-off)
blankets (optional)
volleyball and net (optional)
large size construction paper
blue tempera paint (optional)
paint brushes (optional)

BACKGROUND INFORMATION

Coastal wasters are the waters between the open ocean and the shore. Examples include bays, estuaries, gulfs, sounds, and straits (see definitions below). These waters provide habitats for many different plants and animals. They are rich fishing grounds and serve as nurseries or spawning grounds for many fish and shellfish. They offer year-round recreation opportunities for many people.

They also provide us with some of the fish used in aquariums, some sponge products, and shells which are collected or used to make commercial products.

Terms

bay: a large estuarine system (e.g., Chesapeake Bay).

estuary: the area where a river empties into an ocean; a bay, influenced by the ocean tides, resulting in a mixture of salt water and fresh water.

gulf: a part of the ocean or sea extending into the land.

sound: long, broad inlet of the ocean with its larger part roughly parallel to the coast.

strait: a narrow passageway connecting two large bodies of water.

ADVANCE PREPARATION

A. Prepare transparencies from the teacher sheets “Coastal Waters,” and “United States Coastal Waters,” and one from the student sheet “Coastal Waters Search” (included).

B. Make copies of the student sheet “Coastal Waters Search” (included) for each student.

PROCEDURE

I. Setting the stage

A. Ask the students if they ever visited an ocean beach and went swimming. Tell them that if they have, they have swum in coastal waters.

B. Ask how many have eaten shrimp, oysters, clams, or other types of shellfish. Tell them that those shellfish probably began their life and/or spent a part of their life in coastal waters.

C. Define coastal waters for the students and share the background information with them.

D. Use a globe or world map to point out examples of these coastal waters around the world. For example, point out the Bay of Bengal (between India and Southeast Asia), the Persian Gulf (in the Middle East), the Straits of Hormuz (at the south end of the Persian Gulf) or the Straits of Magellan (south end of South America), and the Mouths of the Amazon (South America) where there are extensive estuaries. Sounds are so small that you probably will not find one on a globe.

II. Activity

A. Display the "Coastal Waters" transparency.

1. Place your finger on the source of the river and trace it to the sea, explaining what an estuary is when you reach the sea.

2. Point out examples of coastal waters and briefly explain what they are. Be sure to include the bay, gulf, strait, and sound. (Include the others if your students are curious about them.)

B. Display the "United States Coastal Waters" transparency. (NOTE: You may wish to use maps or transparencies of other continents for this activity.) Locate and point out some examples of coastal waters, such as the Straits of Florida, the Gulf of Alaska, Long Island Sound, and Chesapeake Bay.

C. Give each student a copy of the student sheet "Coastal Waters Search." (NOTE: You may use this as a small group activity if you wish.)

1. Leave the "United States Coastal Waters" transparency on display for the students' use.

2. Tell the students they are to locate and label on their maps the coastal waters labeled on the transparency. For the estuaries, they should use a crayon or highlighter to mark with an "X" the location of a river's estuary on their maps. (NOTE: You may wish to have students use maps in their social studies books or atlases for this activity.)

III. Follow-Up

A. Review coastal waters terms and definitions.

B. Display the transparency of the student sheet, "Coastal Waters Search."

1. Allow individual students to come up to the projector and label one coastal water on the transparency. (Use a wipe-off transparency pen.)

2. Have the rest of the students check their maps against the transparency.

C. Collect the student sheets and check them for understanding.

IV. Extensions

A. Assign cooperative learning groups to prepare a presentation on a type of coastal water or a coastal water product. On the day of the presentations, have a "Beach Day." Each student should bring a sack lunch and dress for a day at the beach. After their presentations, put down blankets and have a picnic. (NOTE: You might play beach music while the students eat.) Later, go outside and play beach ball volleyball.

B. Have the students do crayon resist art pieces. Give each student a large sheet of white construction or drawing paper. Tell the students to draw a picture of what they think the bottom of a bay, lagoon, or other coastal water might look like. Be sure they include plants and animals they might see. After their crayon drawings are done, have them do a blue wash over their pictures using thin blue tempera paint and paint brushes. You might want to read The Little Mermaid or another appropriate book or story to them as they work.

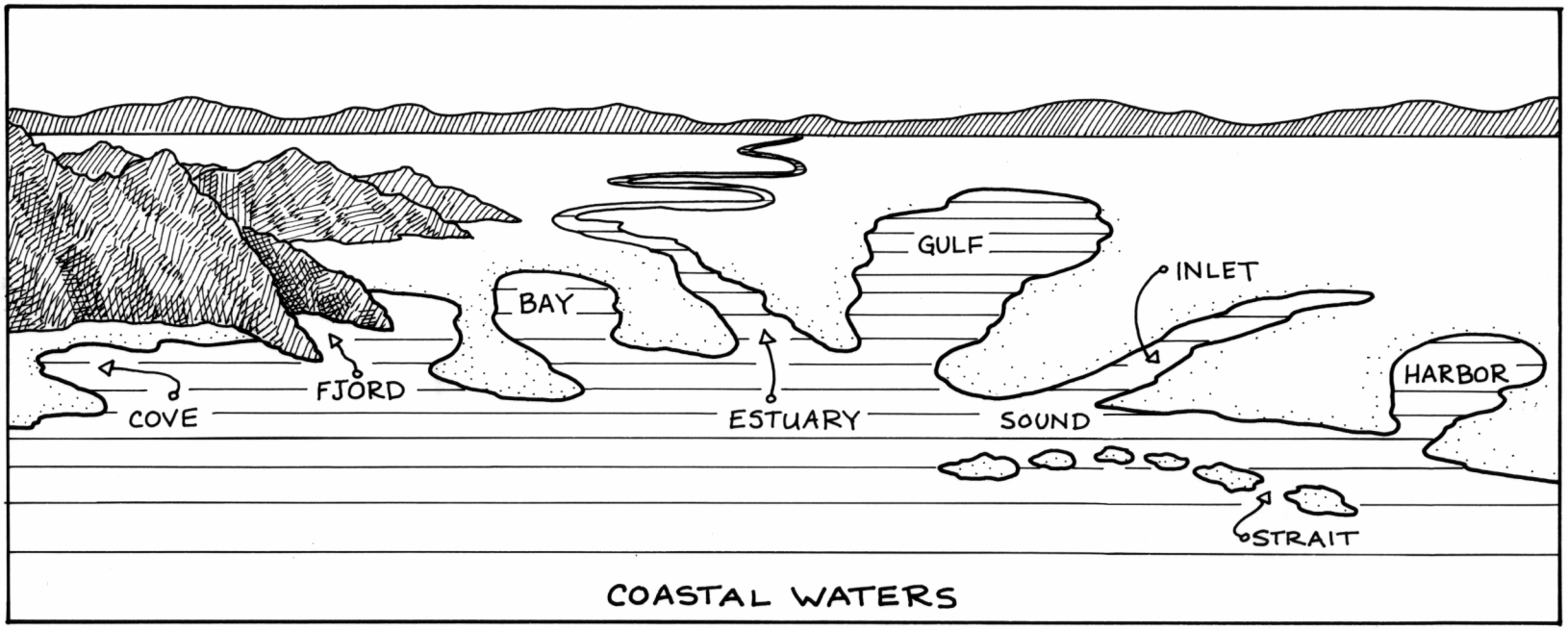
RESOURCES

Hagans, Gloria P., et al., Geography Education Overheads, D. C. Heath and Co., Lexington, Massachusetts, 1989.

Hirst, Stephanie Abraham, Ph.D., The United States: Its History and Neighbors, Harcourt Brace Jovanovich, Orlando, Florida, 1988.

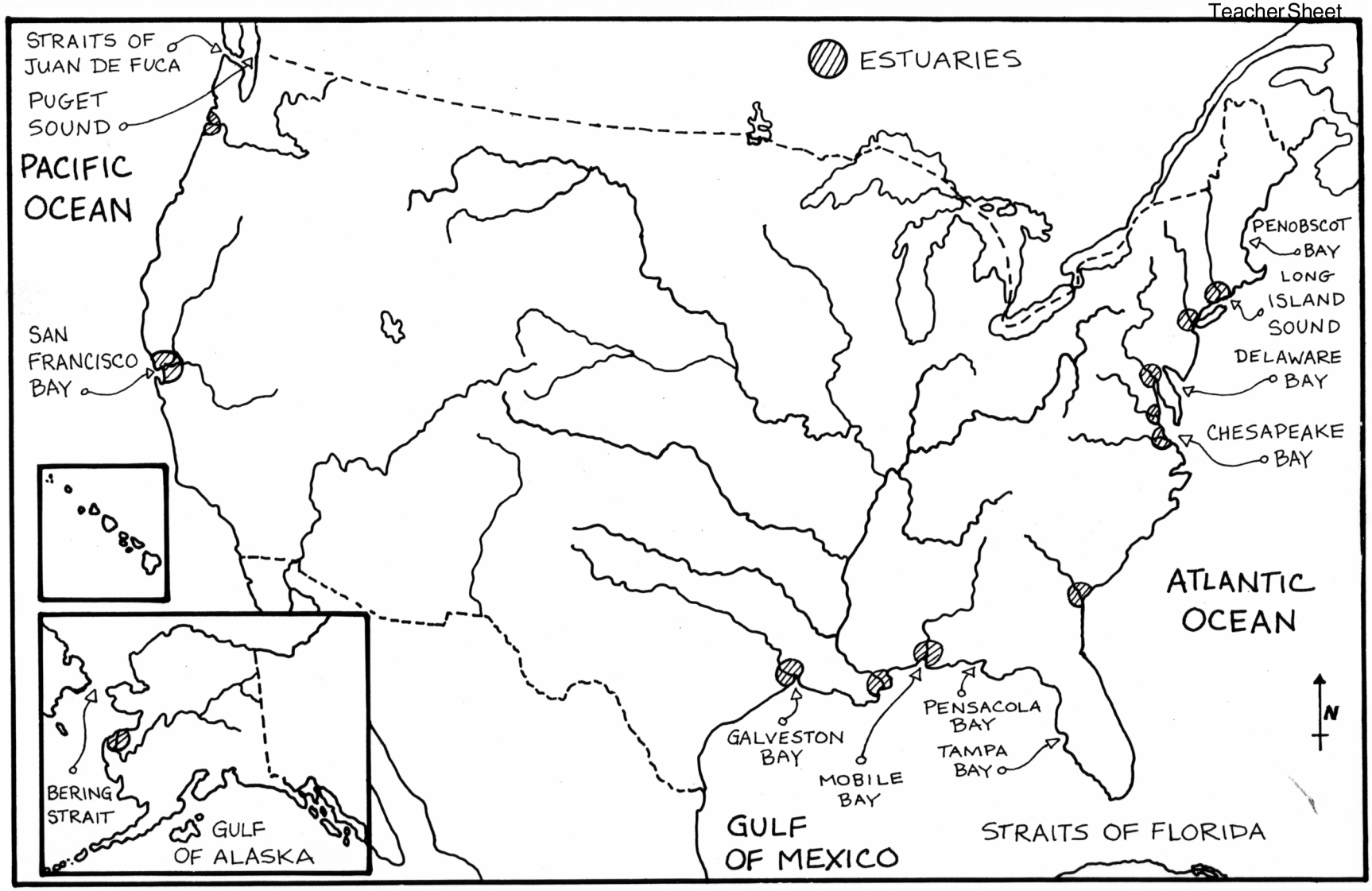
Teacher Sheet

COASTAL WATERS



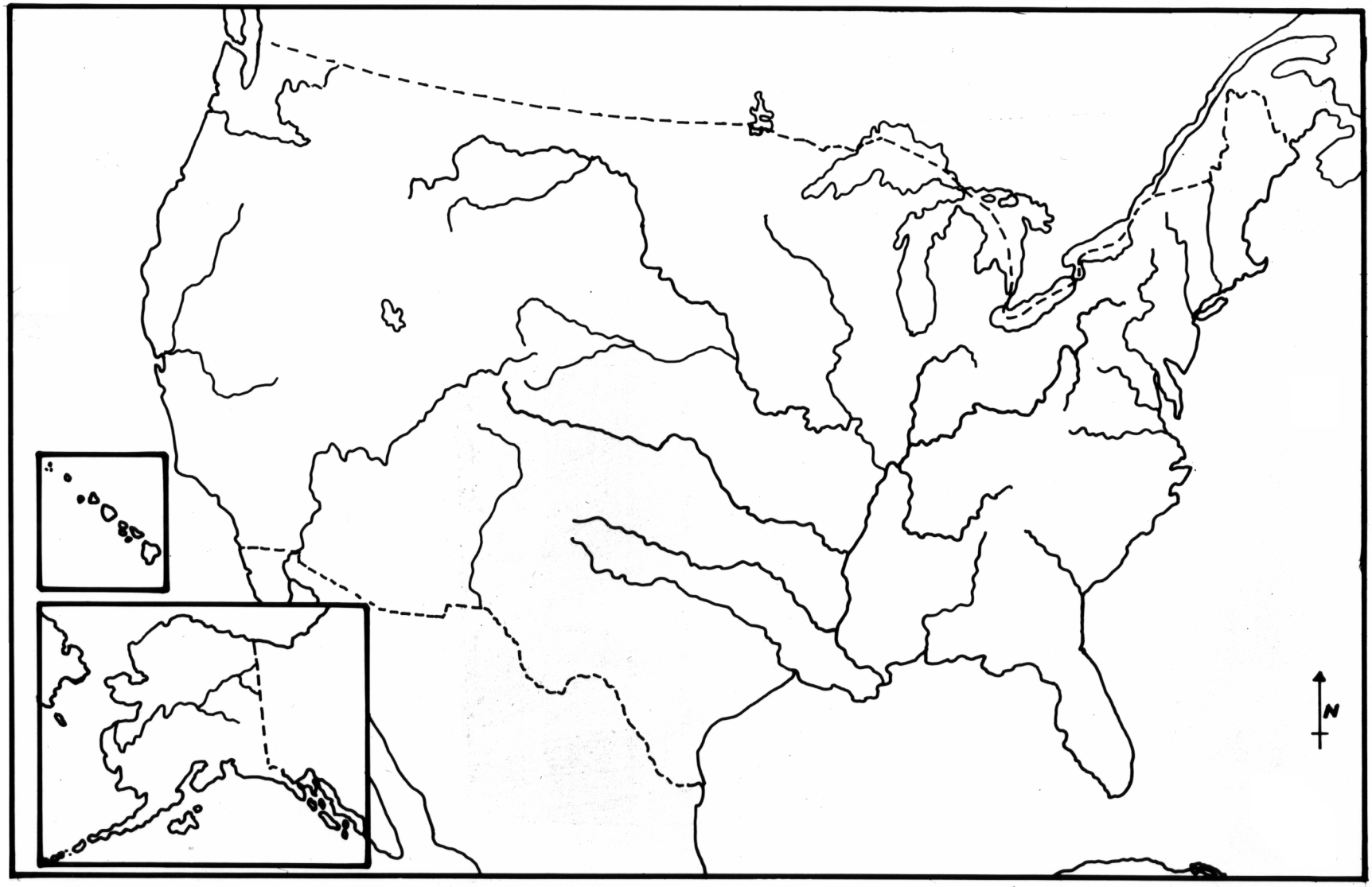
UNITED STATES COASTAL WATERS

Teacher Sheet



COASTAL WATERS SEARCH

Student Sheet



SHEDDING LIGHT ON WATERSHEDS

OBJECTIVES

The student will do the following:

1. Simulate runoff using a watershed model.
2. Explain why rivers are necessary to drain water from watershed area.

SUBJECTS:
Science, Social Studies

TIME:
60 minutes

MATERIALS:
maps showing area watershed (1 per student)
salt flour dough (recipe included)
water
paper
waterproof paint
picture of a river and surrounding area
sprinkling can
9" x 13" (25 x 35 cm) pan — at least 2" (5 cm) deep
drawing paper
measuring cup
world maps (1 per team)
U.S. maps (1 per team)
teacher sheets (included)
transparency
overhead projector

BACKGROUND INFORMATION

The concept of "watersheds" is a useful way to divide areas of land according to how the land and the water flowing over and through it interact. A watershed is an area or region which drains into a particular watercourse or body of water.

Watersheds are important because scientists can study them in order to help determine how much surface water is available for people's needs. The topography, vegetation, soil, rock formations, and climate of a watershed also determine an area's lakes, streams, and rivers.

Generally, two adjacent watersheds are separated by a high area of land called a divide. As an example, the watershed of the Columbia River and America's largest watershed, the watershed of the Mississippi River, are separated by the Great Divide in the Rockies.

Large amounts of runoff from watersheds, occurring in short periods of time, can lead to severe flooding and destruction of land and property. Sometimes heavy rains can result in flooding even when a watershed's rivers are quite large.

Terms

basin: a low lying area where surface water flows, such as a river basin.

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

topography: the physical features of a place or region.

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

ADVANCE PREPARATION

A. Construct a generalized relief map of a watershed. Use salt dough in a pan at least 9" x 13" (25 x 35 cm) and 2" (5 cm) deep. (NOTE: The recipe for salt dough is on the teacher sheet "Salt Dough Relief Map" [included].)

B. Order or locate maps showing your local watershed area. Obtain one per student. (NOTE: Call the United States Geological Surveys Earth Science Information Center at 1-800-USA-MAPS to request specific maps. For local maps, contact the local water department, state agricultural department, state geological survey, or perhaps the department of geology at the nearest college or university.)

C. Obtain enough U.S. maps and world maps for there to be one for each team of four students.

D. If you invite a geologist to class, make sure he/she is informed as to what the objectives are and what to teach the students.

PROCEDURE

I. Setting the stage

A. Show the students a picture of a river and the surrounding lands.

1. Ask the students where the water in the river came from. Write their responses on the board.

2. Explain to the students that most of the water in our rivers comes from water that has drained off the surrounding land. Remind the students that water runs downhill. If it is a rainy day, observe this at your school. What you can observe in your schools' parking lot or yard also happens on a much larger scale over very large areas of land.

3. Discuss the words "runoff" and "watershed."

B. Show your class a transparency or photocopy of the teacher sheet, "Watersheds." Note that it shows two watersheds.

II. Activity

A. Give each student a copy of a watershed map (or any map showing topography) of your local area.

1. Have the students trace some of the paths water takes to get from the various parts of the watershed area to the streams, rivers, and lakes.

2. Ask the students to tell you where they think the river will eventually take the water collected from the watershed area.

B. Present the model of the watershed area to the class.

1. Explain the concepts of valley, hill, mountain, and so forth, to your students by pointing them out on the model.

2. Using a sprinkling can, have it “rain” over the model. Ask the students to observe how water runs over the area and to note where it collects. (the rivers)

3. Explain to the students that areas where water has “pooled” become our bodies of water, such as lakes, ponds, streams, and rivers.

C. Continue sprinkling the model until the pan begins to fill.

1. Explain to the students that if water has no way to be carried off, then flooding occurs. (Flooding also occurs when water cannot be carried off quickly enough.)

2. Ask the students what is needed to carry the water away from the watershed. (river)

III. Follow-Up

A. Ask the students to write a paragraph telling you how a watershed and a river are interrelated.

B. Pass out drawing paper to the students. Have the students draw a watershed area and color it.

C. Divide students into teams of four and give each team a map of the U.S. Assign each team a particular area of the U.S. (New England, Southeast, etc.) and have them find and record the major rivers in that section of the country.

1. Ask the teams to list states that are not part of the Mississippi River watershed.

2. Tell teams to find two rivers that do not empty into another river, but empty directly into the ocean. Explain to the teams that some rivers have very small watershed areas.

D. Pass out the world maps to the teams.

1. Have the teams trace and list a few rivers that flow into Africa’s Congo River. Explain to the teams that the Congo is a major watershed river in Africa.

2. Ask the teams to trace and list some of the rivers that flow into South America’s Amazon River. Explain to the teams that the Amazon River is a major river for South America.

IV. Extension

Invite a geologist to class to explain how topographical maps are made. If possible, request they bring booklets that can be given to each student.

RESOURCE

Douglas, L. S., et al., Experiences in Earth-Space Science, Laidlaw Brothers, Irvine, California, 1985.

SALT DOUGH RELIEF MAP

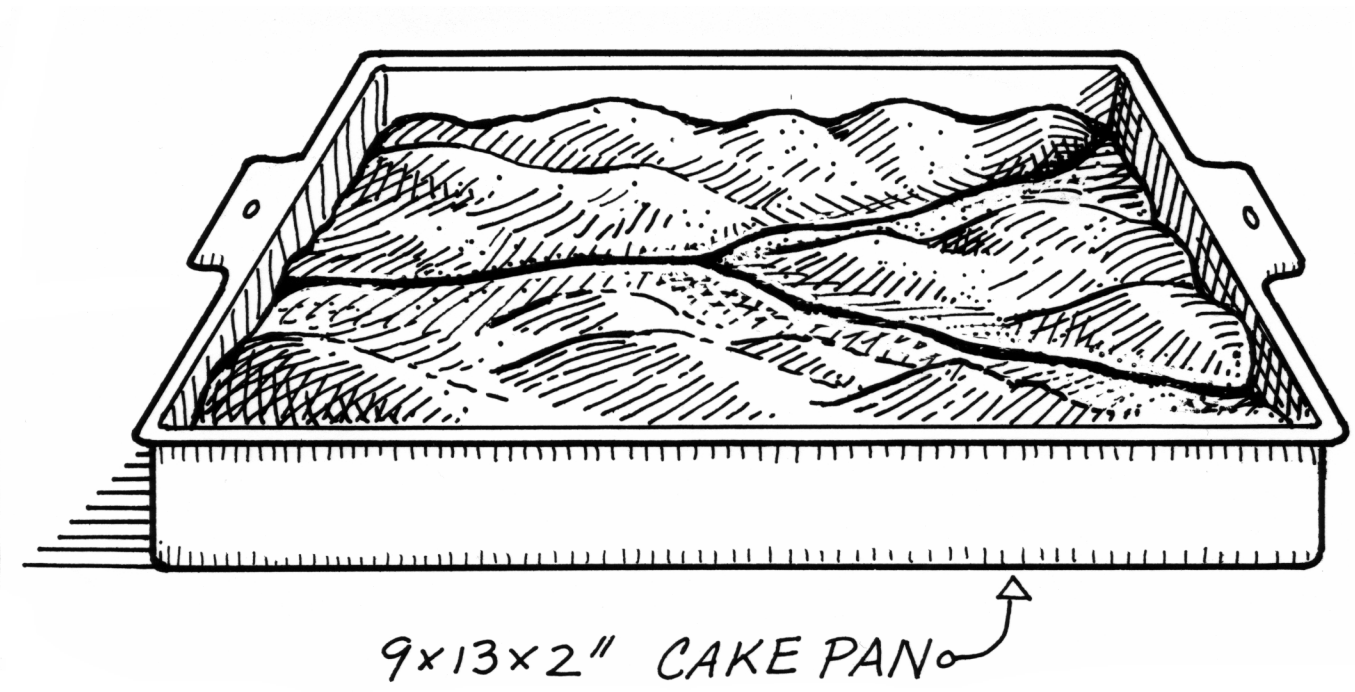
Salt Flour Dough (NOTE: Makes between 1-1/2 and 2 cups of dough. The recipe should be doubled in order to make enough for the relief map. You might make it in 2 batches to ensure success.)

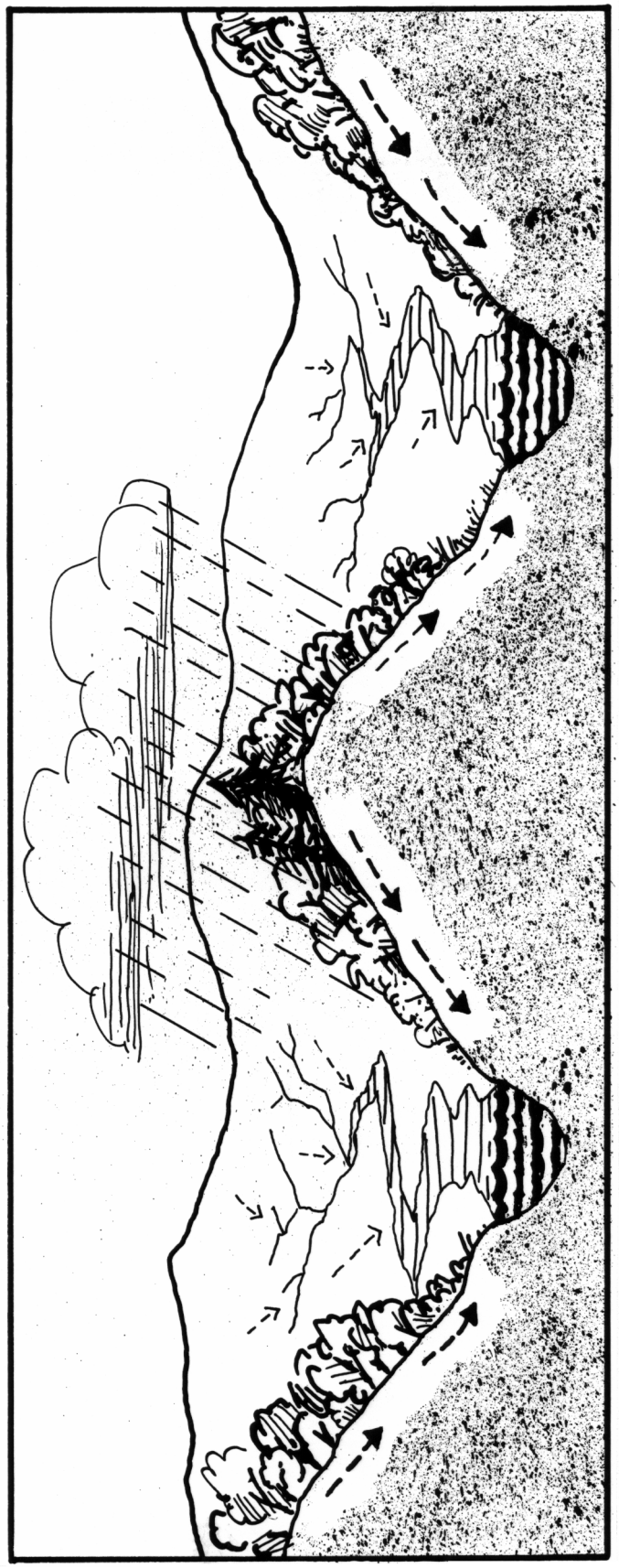
1 cup (250 mL) flour
1/2 cup (125 mL) salt
1 cup (250 mL) water
1 tablespoon (15 mL) cooking oil
2 teaspoons (10 mL) cream of tartar

Mix and heat ingredients until a ball forms. Add a touch of food coloring if desired.

To make model: Try to create a relief map similar to what is depicted on the teacher sheet, "Watersheds." On one end of the pan, let the two major valleys come together to form one larger one (like a "Y"). Make a "riverbed" (depression) at the bottom of each major valley. Make sure that the end of the pan with the bottom of the "Y" is lower than the other end; i.e., the dough should be shallow at that end.

Allow the model to dry. Have several students paint it with waterproof paint. Using waterproof paint protects the model so that it can be reused.





PLANNING LAND USE

OBJECTIVES

The student will do the following:

1. Write about feelings experienced in a wilderness setting.
2. Identify the land use zones on a planning map.
3. Identify land use patterns having possible negative effects on water quality.
4. Redraw existing land use maps for better environmental quality.

SUBJECTS:
Science, Language Arts, Social Studies

TIME:
100 minutes

MATERIALS:
paper
pencils
textbook or magazine pictures
crayons or colored pencils
posterboard
butcher or other large paper (for making rough copies)
rulers
student sheet (included)
local land use planning maps or aerial photographs (optional)

BACKGROUND INFORMATION

People determine how land is used in their communities. These decisions are usually driven by immediate economic considerations. In recent years, however, many communities have begun to plan their growth much more carefully. Part of the reason for this is that people have recognized that environmental quality and aesthetic value — clean, healthful, and attractive characteristics — are important considerations, along with economic concerns. Land use planners now take these less immediate concerns (as compared to economics) into account because the experience of many communities has proved that natural areas do indeed yield economic benefits in the long run by providing aesthetic value and increasing environmental quality.

Natural areas such as parks, tracts of forest or grassland, streams, and ponds are desirable features in any community. They increase an area's "livability," help people enjoy their community, and increase property values. Water bodies are highly desirable to most people. Planning to leave strips of natural area along these watercourses helps to protect water quality by filtering pollutants out of the runoff entering the water; it also provides habitat for plants and animals.

Commercial and industrial land use zones benefit from planned natural areas, as do residential areas. In any densely developed, heavily used area, the creative and sound planning of natural areas yields economic and environmental benefits for now and for many, many years to come.

Terms

agricultural: related to farming.

commercial: businesses, offices, hospitals, and stores.

industrial: factories.

land use patterns: the main ways we use land in specific areas.

open space: land that has no active use by people and is usually forest or grassland.

residential: neighborhoods consisting of houses, apartments, and mobile home parks.

responsible land management: planning for and using land in a way that benefits people and the environment.

ADVANCE PREPARATION

A. Gather the materials for the activity, including textbook or magazine pictures of dense urban areas, natural or wilderness areas, and urban areas that include trees, parks, streams, and so forth.

B. Photocopy the student sheet land use map of our county for each student.

PROCEDURE

I. Setting the stage

A. Have the students complete a sensory writing exercise.

1. Lead the students in a visualization of what it is like to have a wilderness experience. Suggest one involving water, e.g., sitting by a mountain stream hearing the water gurgle and splash over stones. Ask the students to use all their senses. Ask questions such as, "How does the light glisten on the water and move through the forest?" Prompt them with statements such as: Listen to the sounds and recall what the water sounds like and its soothing effect; Smell the forest and feel the cleanness and coolness of the air; Place your hand in the water and feel that it is cold; When you cup it to your nose, it has no smell.

2. Ask the students to then write about their experience and recall their favorite and most vivid images.

B. Discuss with the students the desirability of natural areas — forests, grasslands, streams, and ponds — even in developed or urban settings.

1. Show the students the two contrasting pictures: one of a densely developed urban area that has no open space, natural areas, or water bodies; and one of an urban area including a park or other area having trees, grass, and water (if possible).

a. Ask the students which picture they think represents the best place to live. Discuss their reasons for their choices. (They will probably prefer the area with the natural areas. Lead them to identify the natural areas and water bodies as desirable.)

b. Discuss with the students the picture of the heavily developed city scene again. Ask them what could be done to make this setting more desirable. (parks, trees, ponds, etc.)

2. Discuss with the students that people can plan ahead as they build their communities so that they can include natural areas (including water). If there are good local examples (parks, greenbelts, etc.) with which the students would be familiar, discuss these.

II. Activities

A. Introduce the students to the concept of responsible land management as discussed above.

B. Give each student a copy of the student sheet "Land Use Map." Explain that a land use map is a map that shows how we can use land, i.e., for what purposes local government has designated certain areas. Using the term definitions and the student sheet, explain the land use areas on the map. Discuss with them how the land use patterns may be detrimental to environmental quality. Note that:

   1. Residential areas have no open spaces planned.

   2. No open space is planned along creeks.

   3. Commercial areas and industrial areas have limited open space planned.

   4. There are industries located on streams.

C. Stress to the students that water is an important component of environmental quality. That is, wherever there is a “clean” environment, there is good water quality and vice versa.

D. Have the students complete the following planning activities.

   1. Reemphasize the importance of clean water. (All living things must have it.) Remind the students that we are “stewards.” “Stewardship” means taking care of our world and its resources. We must take care of our water and land.

   2. Direct the students’ attention to the land use maps.

      a. Group the students in teams and have them look at their planning maps. Tell them that the purpose of this activity is to look at the ways people use the land. If we plan to protect the environment, then life will be better for all of us.

      b. Tell the students that they will first analyze the map, looking for potential environmental problems. Have them look for possible sources of pollution or other things that affect water quality. Have them think about what they would like to have where they live. (For example, would they want to live right next door to a factory? Would they like to have a forest near where they live?)

      c. Ask what activities fit or do not fit into the zones.

      d. Allow the students to discuss their observations for five minutes, then ask the teams to list a proper and an improper use for each zone. Write their responses on the board.

   3. Ask the students the following questions about existing land use. Have them identify the following on their maps.

      a. What is a residential area? commercial area? industrial area? open space area?

      b. On the map’s legend, rank each of the land use areas from most area to least area in terms of size. (Have them number them with pencils.)

      c. In which direction are the creeks flowing? (Have them trace the creeks with their fingers.)

d. List three land uses near creeks.

e. Describe three possible bad effects of these land uses near creeks. Why would these be bad?

III. Follow-Up

A. Tell the students to imagine now that each team is going back 40 years into the past and is going to make a land use plan. Remind the students of the need for environmental quality and quality of life for people, including water quality. Have the students imagine they are going to live in the community; they should make changes that they would like to see happen.

B. Allow time for team discussion and making a "rough" copy of their new land use map. Supply copies of the unmarked land use map for their use.

C. Ask the students to answer the following questions when they complete their new land use plans.

1. What is the biggest problem with the old map? Why?

2. What else is a problem? Why?

3. How will you solve these problems?

4. Could there be problems with your solutions? What might they be?

5. How would you make the residential areas better?

6. Was there disagreement in the team about land uses? How was the disagreement solved?

D. After answering the questions, have the teams redraw a final copy of their map on posterboard. Have them present the new plan to the class.

IV. Extension

A. Obtain planning maps or aerial photographs of your home community. (Check with your local Metropolitan Planning Commission or similar agency.) Let them analyze them as they did in this exercise.

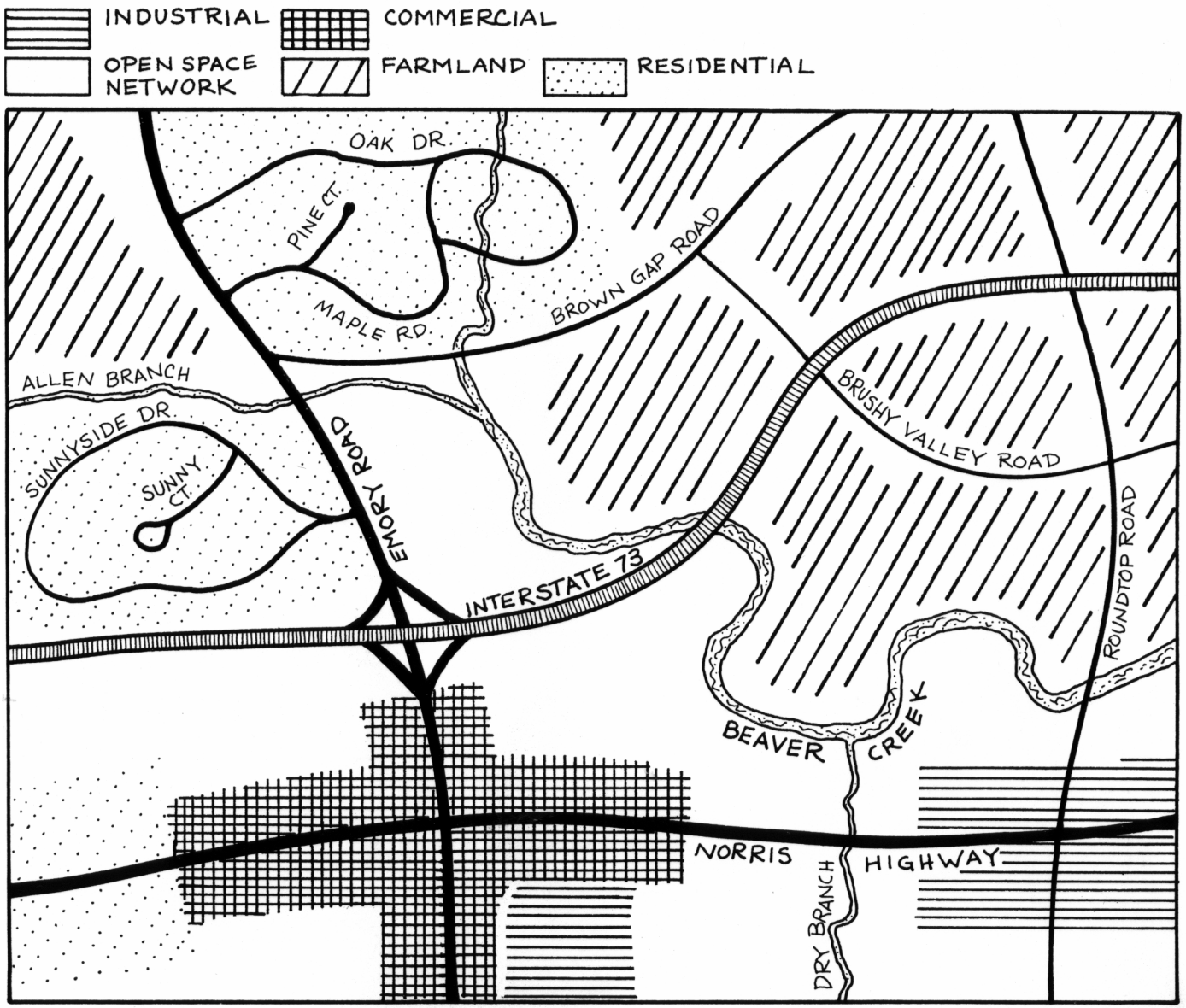
B. Invite a member of the local planning commission to talk to the students about local planning issues.

C. Have the students write songs or poems about water quality and responsible land management.

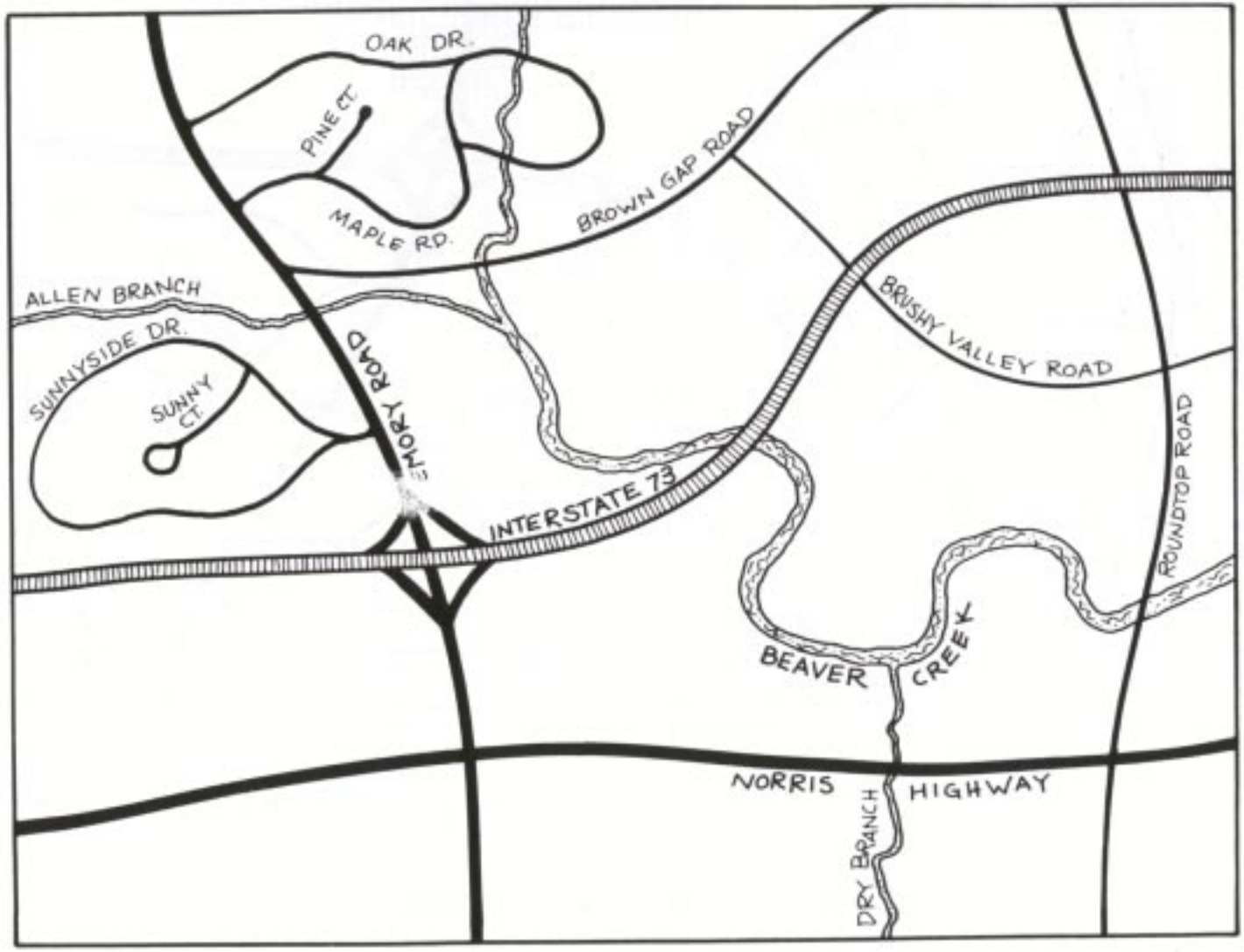
RESOURCES

Investigating the Human Environment: Land Use, Biological Sciences Curriculum Study, Teachers Guide, 1984 (ISBN 0-8403-3319-6).

O'Connor, Maura, "Living Lightly in the City," Schlitz Audubon Center, 1982.


INDUSTRIAL
COMMERCIAL
OPEN SPACE NETWORK
FARMLAND
RESIDENTIAL
OAK DR.
PINE CT.
MAPLE RD.
BROWN GAP ROAD
ALLEN BRANCH
SUNNYSIDE DR.
SUNNY CT.
EMORY ROAD
INTERSTATE 73
BRUSHY VALLEY ROAD
ROUNDTOP ROAD
BEAVER CREEK
NORRIS HIGHWAY
DRY BRANCH

MAKE YOUR OWN LAND USE PLAN



WHAT'S THE DIFFERENCE?

OBJECTIVES

The student will do the following:

1. Distinguish between water pollution and water contamination.
2. Identify water pollutants and water contaminants.
3. Write sentences differentiating between water pollution and water contamination.

SUBJECT:
Science, Art, Language Arts

TIME:
60-90 minutes

MATERIALS:
pitcher of tap water
2 clear quart containers
or two 1-liter bottles with tops cut off
small amount of bleach, fertilizer, detergent, motor oil, vinegar, soil
small leaf, twig, and dead insect
1 piece 18"x12" (45 x 30 cm) construction paper per student
crayons
student sheets (included)
teacher sheet (included)
baby food jars
wide-range pH paper

BACKGROUND INFORMATION

Water contamination is pollution that occurs when materials of natural origin (such as soil, silt, or algae) gives water an earthy, fishy, woody, or other unpleasant taste or odor or discolors it.

Water pollution is pollution that occurs when unwanted wastes (such as sewage, industrial wastes, and agricultural wastes) are released into water sources. This is a result of human activities.

Terms

water contamination: the dirtying of water resources by natural materials.

water pollution: the dirtying of water resources, especially by human-generated wastes.

ADVANCE PREPARATION

A. Gather contaminants: small leaf, twig, dead insect, and soil.

B. Gather pollutants: fertilizer (represents agricultural waste), bleach and vinegar (represent industrial waste), and detergent and motor oil (represent domestic waste). Make sure all pollutants are properly disposed of after use (read their labels carefully).

C. If you choose to do the experiment in part IV.A, gather materials. You will need 1 jar and 1 pollutant or contaminant and a copy of student sheet "Experiment Journal" per team. Also, if you choose to use the pH paper, you will need to acquire it now. Call Carolina Biological Supply (800-334-5551) or other supply companies. You may be able to get some from a high school science teacher.

D. If you choose to do the fill-in puzzle in part IV.B, make a copy of the student sheet "What Is It?" for each student.

PROCEDURE

I. Setting the stage

A. Pour water into the two containers until they are about half full. Ask if there is any difference between the two jars of water.

B. Add a pollutant to one of the jars and a contaminant to the other. Again, ask if there is any difference between the two.

C. On the board write the words "Water Pollution" and "Water Contamination" and draw a vertical line between the two to make a chart. Under Water Pollution write "Human cause" and under Water Contamination write "Natural cause." Explain the difference to the students, giving examples like the following: After heavy rain, streams and rivers sometimes turn "muddy" because they are carrying a lot of silt that washed into the river from the land. Sometimes in the summer, a lot of algae grows in the water and makes it taste bad. These are examples of water contamination. If people cause things like chemicals or human or animal wastes to be put in streams or rivers, this is called water pollution.

D. Refer the students back to the two jars and ask them which is the pollutant and which is the contaminant.

II. Activity

A. Distribute construction paper to students and tell them to fold it in half lengthwise. With a crayon, ask them to draw a line down the fold, then label the left side "Water Pollution" and the right side "Water Contamination."

B. In indiscriminate order, hold up the pollutants and the contaminants and explain what they are and what they represent. As you hold them up, have students write down the material in the correct column to indicate whether it is a pollutant or a contaminant. (NOTE: You may want to have a chart prepared with the materials listed for younger students to refer to.)

C. After you have displayed all the materials, go back over them with the students and ask them to tell you which column they belong in and why. Be sure to stress the difference: Pollution is the result of humans; contamination is the result of natural causes. Have students check and correct their charts as you do this.

III. Follow-Up

A. Review what water pollution and water contamination are. Ask students if they can think of other pollutants and contaminants. Add answers to chart, if appropriate.

B. Have students turn their papers over and draw another line down the fold. Tell students to draw a simple picture of a body of water (creek, river, lake, etc.) with a pollutant in it on one side and a body of water with a contaminant in it on the other side. Below the pictures, students should write complete sentences telling what the material is, whether it is a pollutant or contaminant, and why they classified it as such.

C. Collect papers and display them on a bulletin board.

IV. Extensions

A. Experiment

1. Divide students into six teams. Pour water into six baby food jars and place a pollutant or contaminant in each jar. Assign a jar to each team. Label the jars and place in a bright location. Do not place in direct sunlight.

2. Give each group a copy of student sheet "Experiment Journal" and have them fill out #1.

3. Tell students that each team is going to conduct an experiment on their water over the next four weeks and they are going to keep a journal of what happens during the experiment.

4. Have students fill out #2.

5. Allow teams 5 minutes to discuss their hypotheses, then write it down in #3.

6. Each week, allow teams time to write down their observations in their journals. If possible, supply teams with pH paper and allow them to test their water each week. (NOTE: See Advance Preparation for suppliers of pH paper.)

7. At the end of the experiment, allow time for the teams to draw a conclusion and record it in the journals. Then, have the teams share their journals and tell the class what happened.

8. To wrap it up, give teams 5 minutes to brainstorm an answer to the question "What can you do?" When doing this, tell students to think about prevention as well as a solution to the problem after it has already occurred.

B. Word Fill-in Puzzle

1. Give each student a copy of student sheet "What Is It?" and tell them to fill in the spaces using the words listed at the top. This is similar to a crossword puzzle.

2. Tell them that all horizontal words are pollutants and all vertical words are contaminants, or you may ask them if they can figure out the pattern themselves. (NOTE: The first step toward solving the puzzle is to sort the list into 2 categories.)

3. Challenge students to come up with more contaminants and pollutants to add to the puzzle.

C. Creative Writing

1. Tell students they are going to write a story about water pollution from a bear's point of view.

2. Ask them to close their eyes and imagine they are each a bear while you read the story starter on the "Bear Necessities" teacher sheet.

3. After reading the story starter, tell students to finish the story from the bear's point of view. Ask them to imagine that the water has been polluted and tell what the bear thinks and feels, and what the bear family will do.

RESOURCES

Arnold, Caroline, Bodies of Water Fun, Facts, and Activities, Franklin Watts, New York, 1985.

Carlson, Carl W. and Bernice W. Carlson, Water Fit to Use, Day Co., New York, 1972.

Slattery, Britt E., WOW! The Wonders of Wetlands, Environmental Concern, Inc., St. Michaels, Maryland, 1991.

Student Sheet

EXPERIMENT JOURNAL

1. Names of people on team: _____

_____

_____

2. Problem: _____ is a _____
(material in water) (contaminant/pollutant)

It looks _____

and smells _____

3. Hypothesis: _____

_____

_____

4. Week 1: _____

_____

_____

5. Week 2: _____

_____

_____

6. Week 3: _____

_____

_____

7. Week 4: _____

_____

_____

8. Conclusion: _____

_____

_____

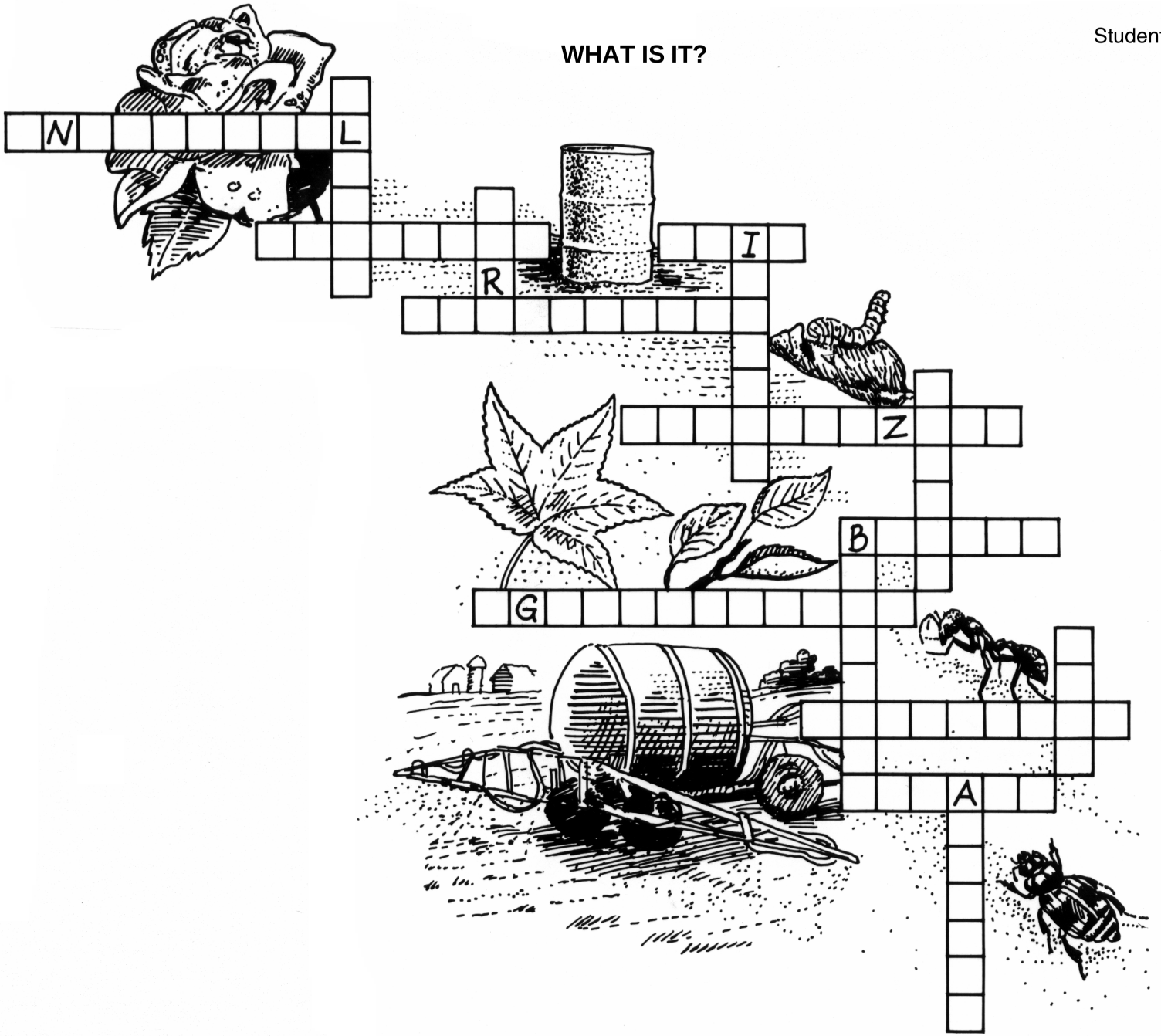
Teacher Sheet

STORY STARTER: BEAR NECESSITIES

Summertime is a good time to be a bear! There are lots of good things to eat so we have lots of energy

Student Sheet

WHAT IS IT?



to run and play in the forest. But even with all the trees for shade, we still get hot with all this thick fur covering us. One of our favorite things to do after a long, hot, tiring game of tag is to get a nice, cool drink of water from the stream, find a big tree to scratch our backs against, and then lay down in its shade for a nap.

This morning, my sister and I played tag for the longest time. We were looking forward to a refreshing drink of water but when we got to the stream, the water . . .

(NOTE: Now have the students finish the story.)

FOR SALE: USED WATER

OBJECTIVES

The student will do the following:

1. Describe and locate the parts of the drinking water treatment system: source, treatment, and distribution.

2. Describe and locate the parts of the wastewater treatment system: collection, treatment, discharge.

3. Describe the differences between drinking water treatment and wastewater treatment.

4. Locate and label the parts of their home's drinking water system and wastewater system.

SUBJECTS:
Science, Art, Math

TIME:
100 minutes

MATERIALS:
2 opaque plastic pitchers
tea bag
acetate sheets
2 clear glasses
tap water
posterboard
student sheets (included)
teacher sheets (included)

BACKGROUND INFORMATION

The amount of water on earth has always been the same. Water moves through the water cycle and is not destroyed. Three-fourths of the earth is covered by water. Oceans (salt water) make up 97 percent of earth's water, glaciers and ice caps make up 2 percent, and fresh water makes up 1 percent.

A commercial drinking water treatment system has three basic parts: source, treatment and distribution. Well water typically has a source and distribution although some well water is also treated. Sources of drinking water are surface water (streams, rivers, man-made reservoirs) and groundwater (water underground). Once collected, water is treated with chemicals to kill bacteria; remove contaminants, bad tastes, and odors; and clump solid particles together. The chemicals and particles settle out and the water is filtered through layers of sand, gravel, and charcoal. The last step is adding chlorine to disinfect, or kill bacteria, before distribution through many water pipes.

Once water is used it leaves your house as wastewater. The three parts of a wastewater treatment system are: collection, treatment, and discharge. Wastewater is collected in large pipes and sent to the wastewater treatment plant for primary treatment to have solid wastes removed by bar screens and settling tanks, for secondary treatment by aeration and growth of good bacteria and settling again, then advanced treatment where chlorine is added to further disinfect the water before it is discharged into the receiving stream or lake. Some homes may have a septic system which has a settling tank and drain field.

Terms

drinking water: cleaned and treated water ready to drink.

wastewater: water that has been used for domestic or industrial purposes.

water source: surface water (lakes, rivers and streams) and groundwater.

ADVANCE PREPARATION

A. Determine whether you will cover urban drinking and wastewater treatment, or rural well water and septic systems, or both. Choose whichever is appropriate for your students and delete the student sheets and teacher information you do not need.

B. Place a tea bag in a pitcher of water and leave it overnight. This will represent "dirty water." Keep it in a container that you can't see through.

C. Fill another pitcher with fresh tap water.

D. Post headings on the chalkboard (or posterboard) as follows:

Running Water	Sources of Water	Cleaning Drinking Water	Where Does Water Go?	Cleaning Wastewater

E. Make an overhead transparency of each of the four teacher sheets, "Drinking Water Treatment Plant," "Well Water," "Wastewater Treatment Plant," and "Septic System."

F. List terms and definitions on the board.

G. Copy the student sheets "Home Survey," "Drinking Water Treatment Methods," and "Wastewater Treatment Methods" for each student.

PROCEDURE

I. Setting the stage

A. Begin by asking who would like a drink of cool water.

1. In one glass pour the "clean" water and in the other glass pour the "dirty" water. Ask, "Which water would you like to drink?"

2. Ask how water gets "dirty." How does it get "clean?" Tell the class that today we are going to find out how our drinking water and wastewater are cleaned.

B. Ask the class the following questions to begin a question and answer discussion about water and list the answers on the board under the headings.

1. Where are some places we have running water? (homes, schools, businesses, etc.)

2. Can anyone tell me where your water comes from?

3. How is our water cleaned before we drink it?

4. Does anyone know where your water goes when it does down the drain?

5. Does the water that goes down the drain get cleaned?

II. Activity

A. Pass out the student sheets “Drinking Water Treatment Methods” and “Wastewater Treatment Methods”.

B. Using the teacher sheet overhead transparencies “Drinking Water Treatment Plant,” “Well Water,” “Wastewater Treatment Plant,” and “Septic System,” lead the class through each diagram and have them label each stage of treatment.

C. Pass out the take home survey sheet (student sheet “Home Survey”) and go over the directions. Tell the students to bring their sheets back the next day after completing the survey.

D. The next day make sure all students have the worksheets “Drinking Water Treatment Methods,” “Wastewater Treatment Methods,” and “Home Survey.” Explain that each person will diagram or draw his or her house and its drinking water supply system and wastewater disposal system and label all the parts.

III. Follow-Up

A. Display diagrams in the room or in the hallway.

B. Compile data from home survey sheets on the board under the headings: city water, well water, sewer, septic tank.

C. Have students make a pie chart to compare the percentages of each response.

IV. Extension

A. Have a representative from the drinking water treatment plant and/or wastewater treatment plant come and speak to the class, or take a field trip to your community’s treatment plants.

B. Have a representative from the public health department come to talk to your class about well and septic system safety.

C. Make a mobile showing parts of drinking water treatment and waste water treatment systems.

RESOURCES

Bernstein, Leonard, et al., Concepts and Challenges in Earth Science, Globe Book Co., Englewood Cliffs, New Jersey, 1991.

Cobb, Vicki, The Trip of a Drip, Little, Brown and Co., Boston, Massachusetts, 1986.

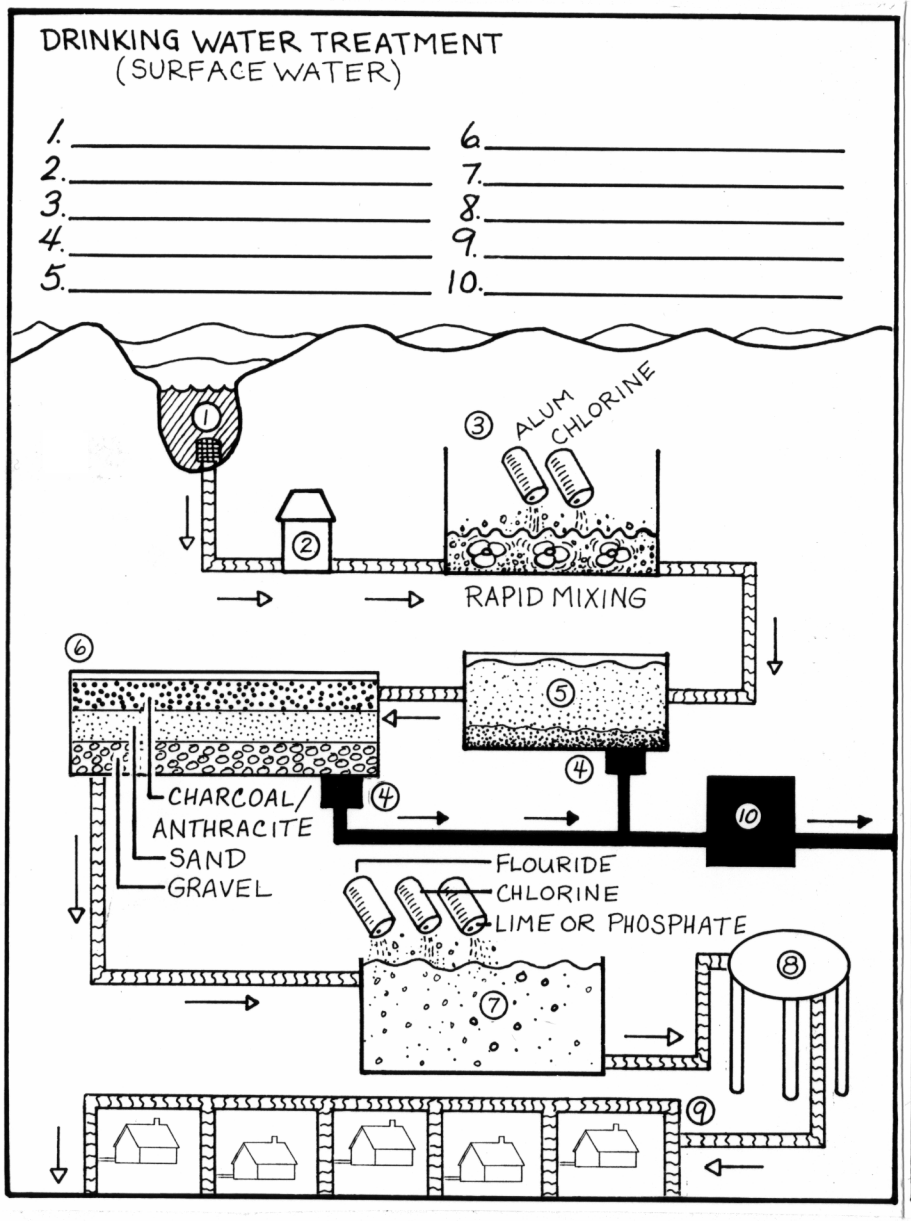
"Lets' Learn About Wastewater Treatment," Channing L. Bete Co., South Deerfield, Massachusetts, 1981.

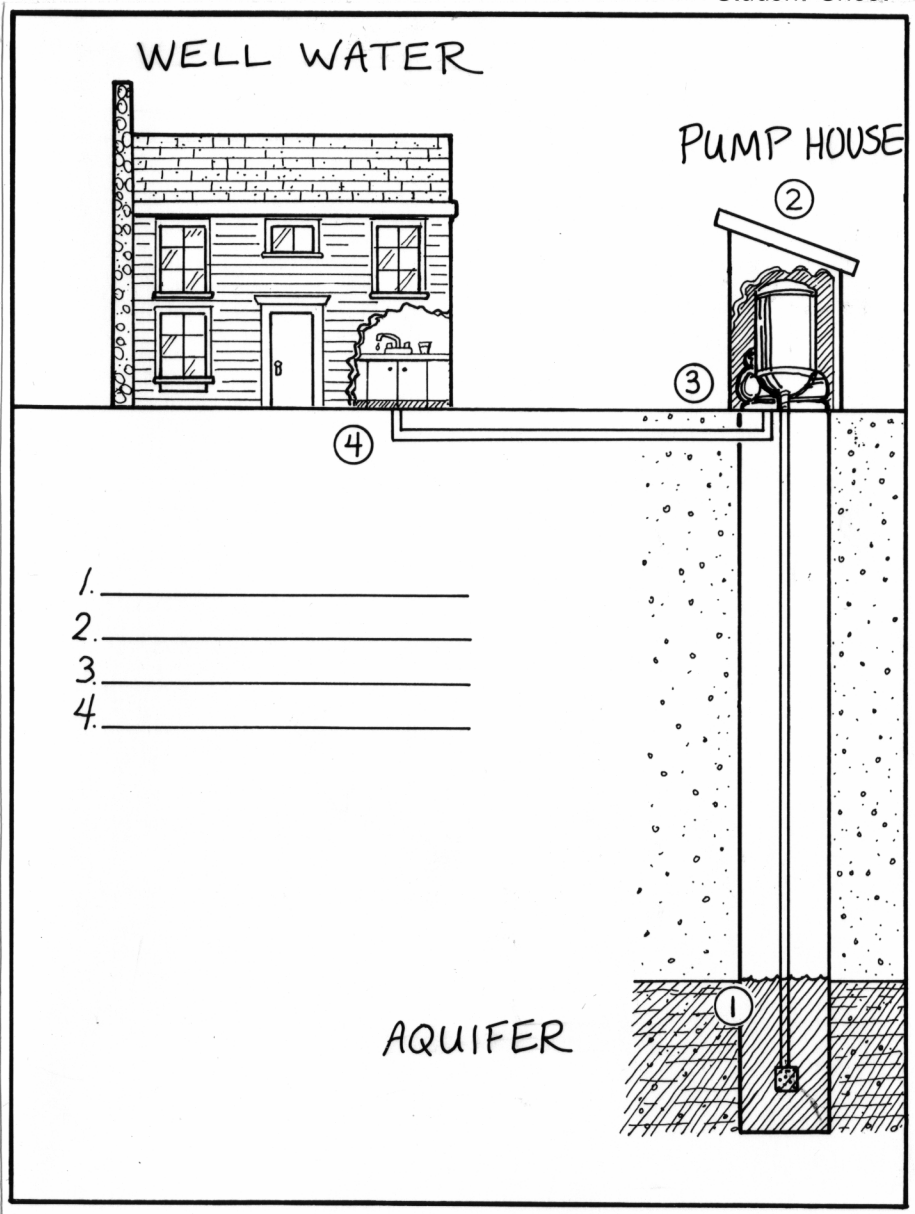
"The Story of Drinking Water," American Water Works Association, Denver, Colorado, 1984.

Teacher Sheet

DRINKING WATER TREATMENT METHODS

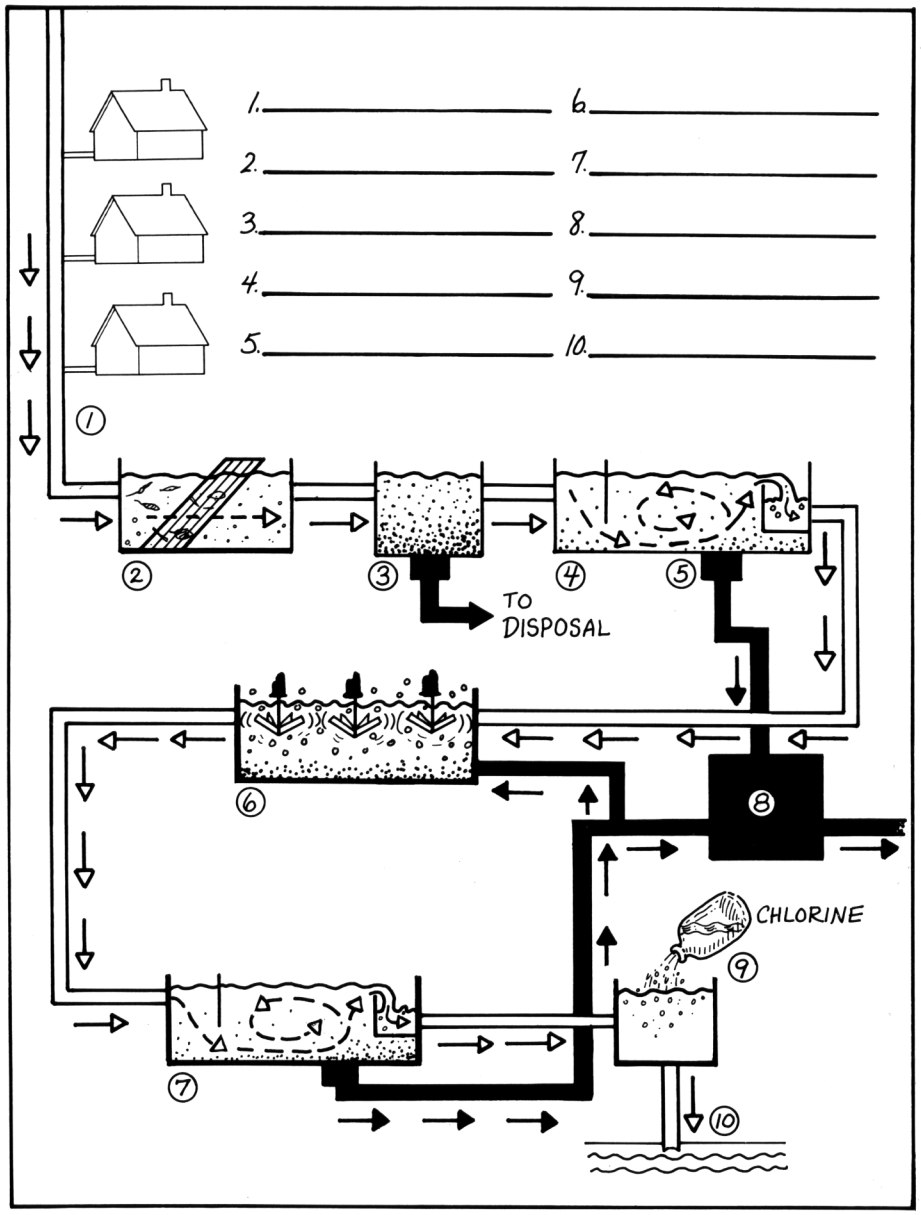
Student Sheet

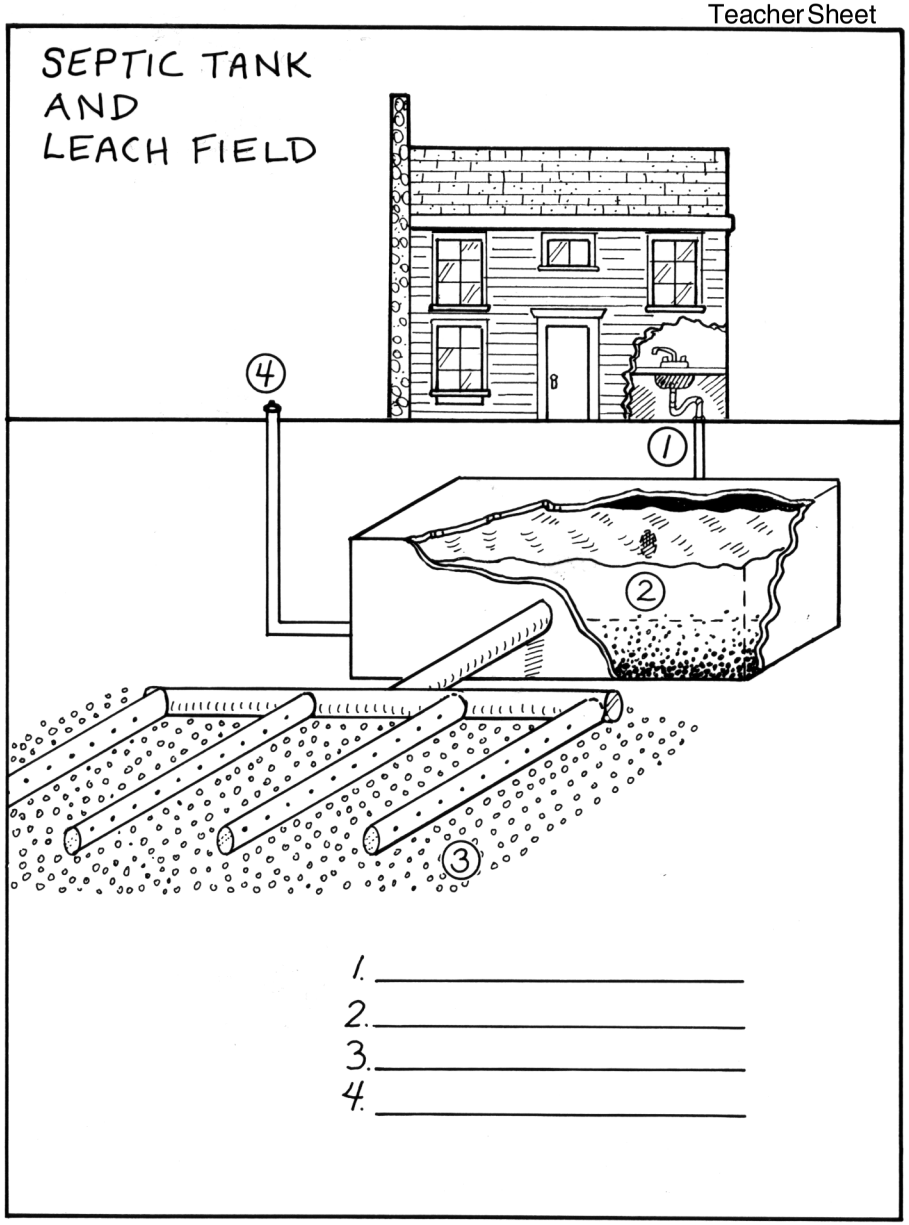




WASTEWATER WATER TREATMENT METHODS

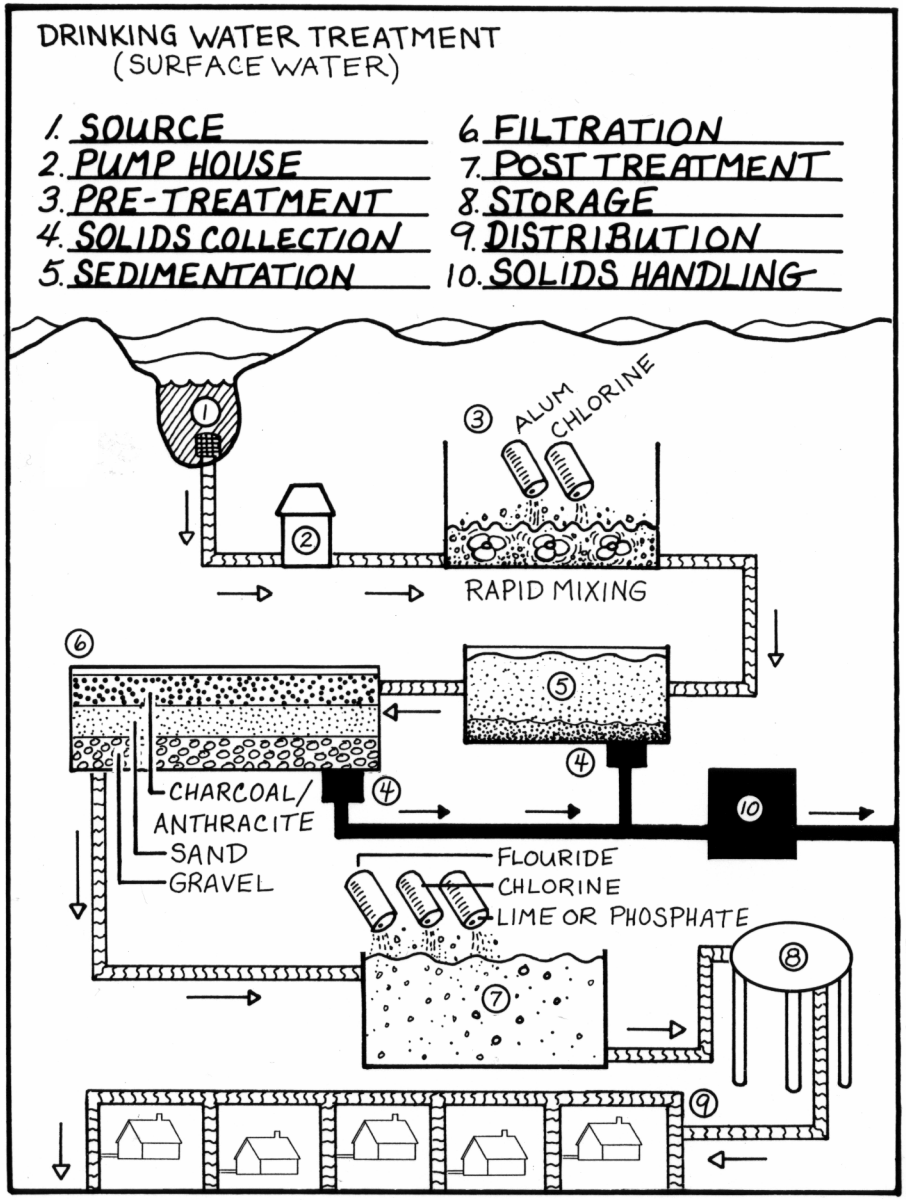
Teacher Sheet

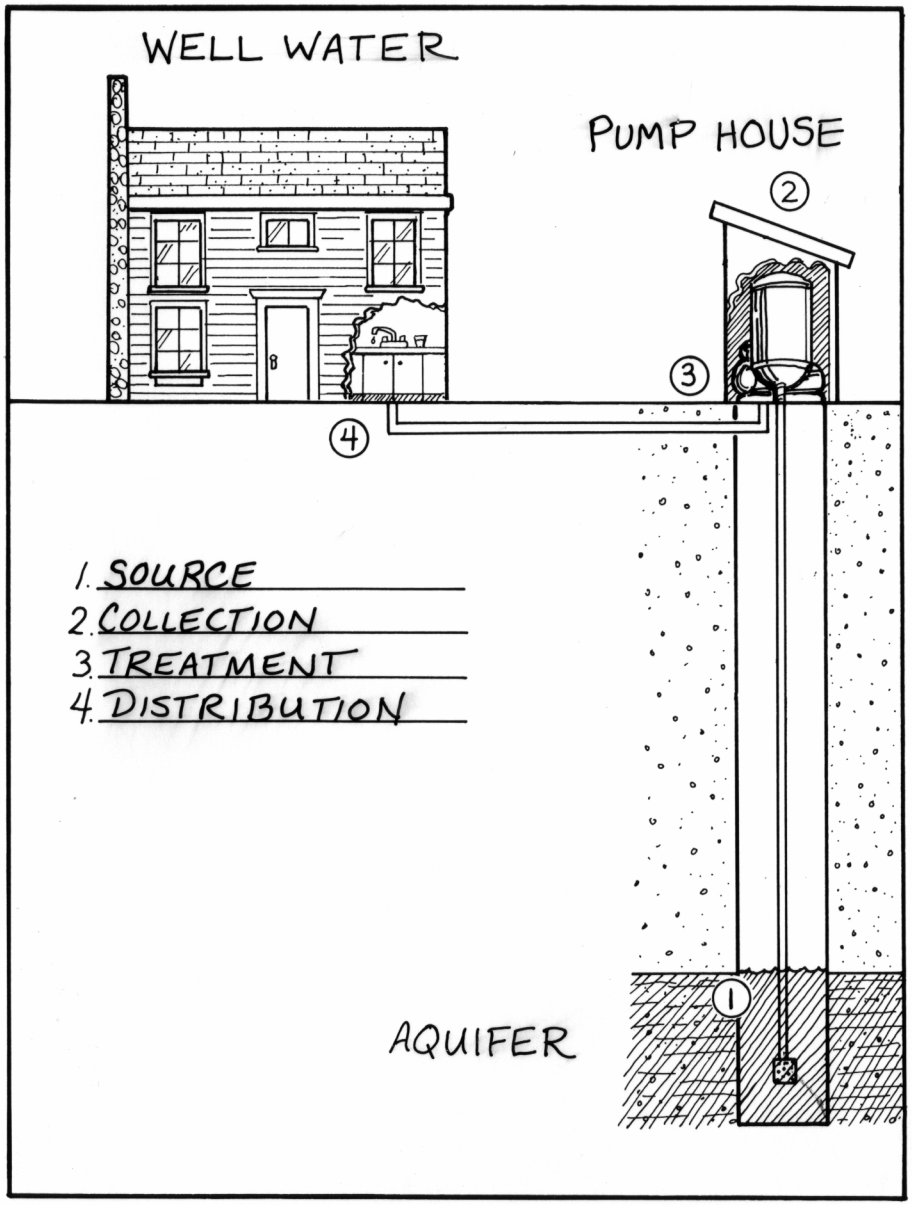




DRINKING WATER TREATMENT METHODS
ANSWER KEY

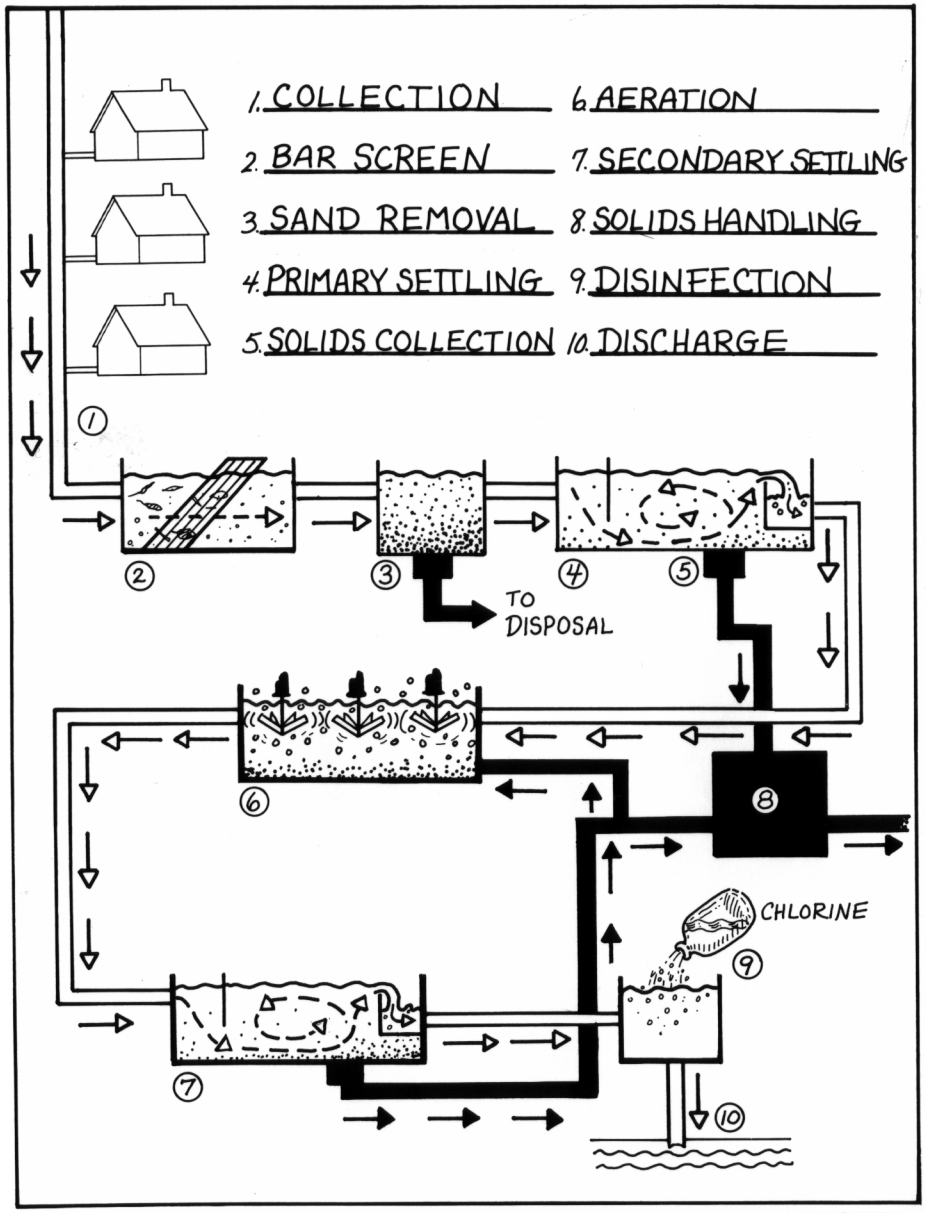
Teacher Sheet

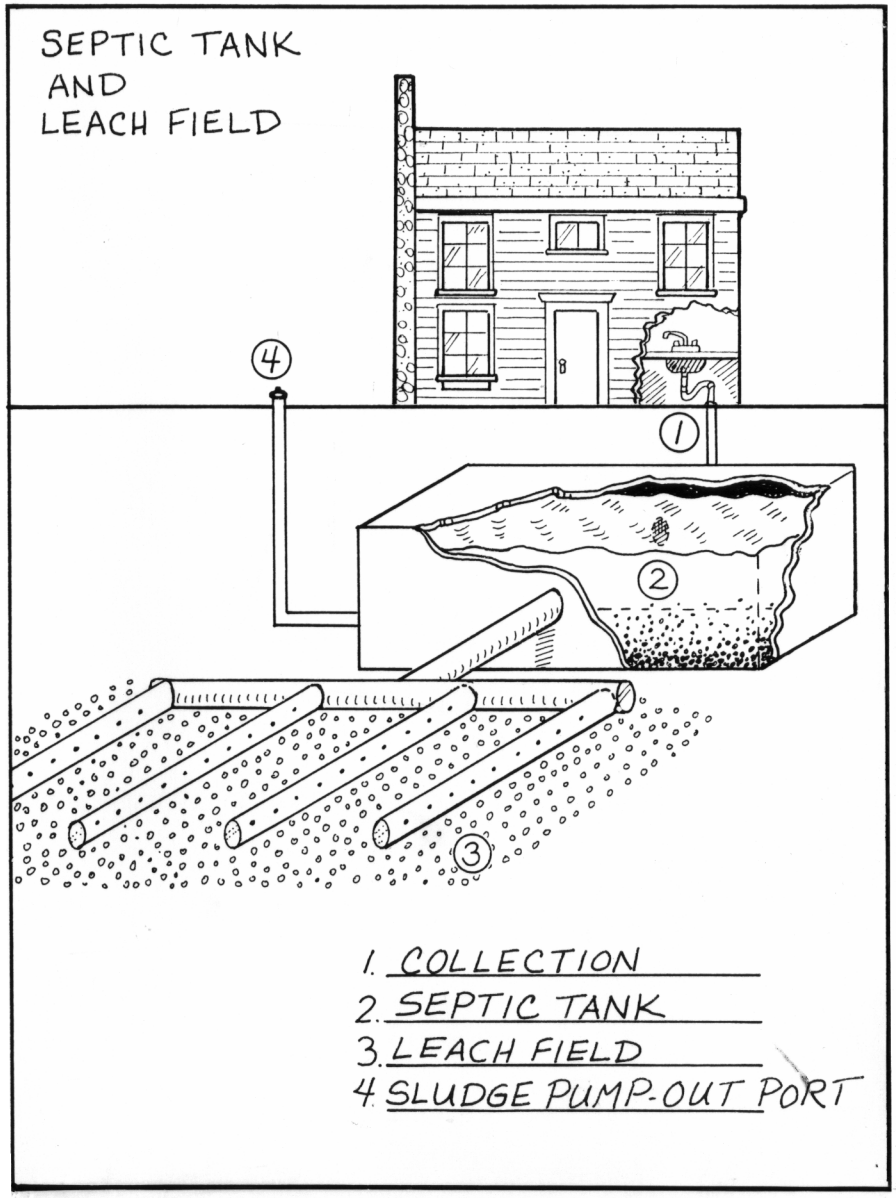




WASTEWATER WATER TREATMENT METHODS
ANSWER KEY

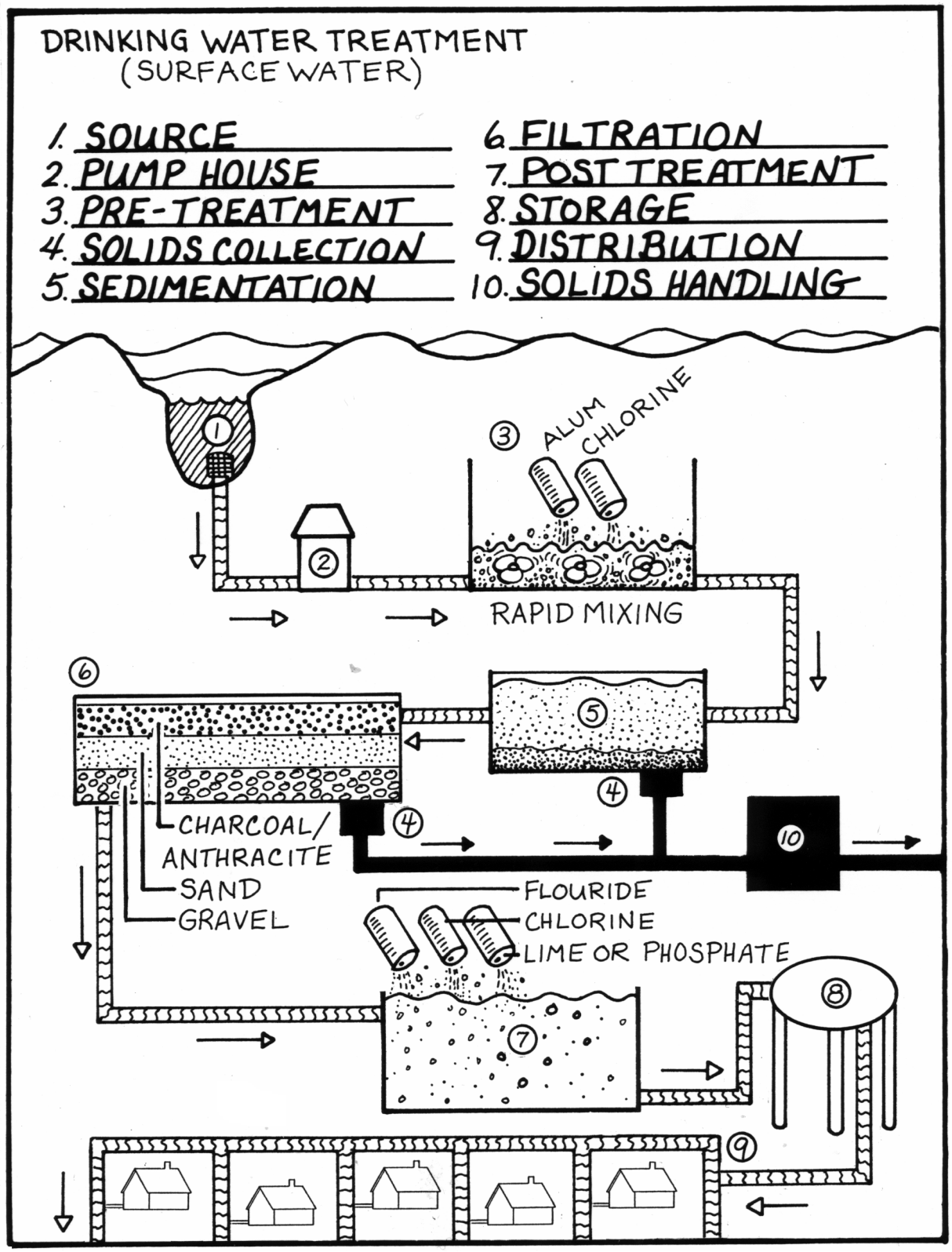
Teacher Sheet

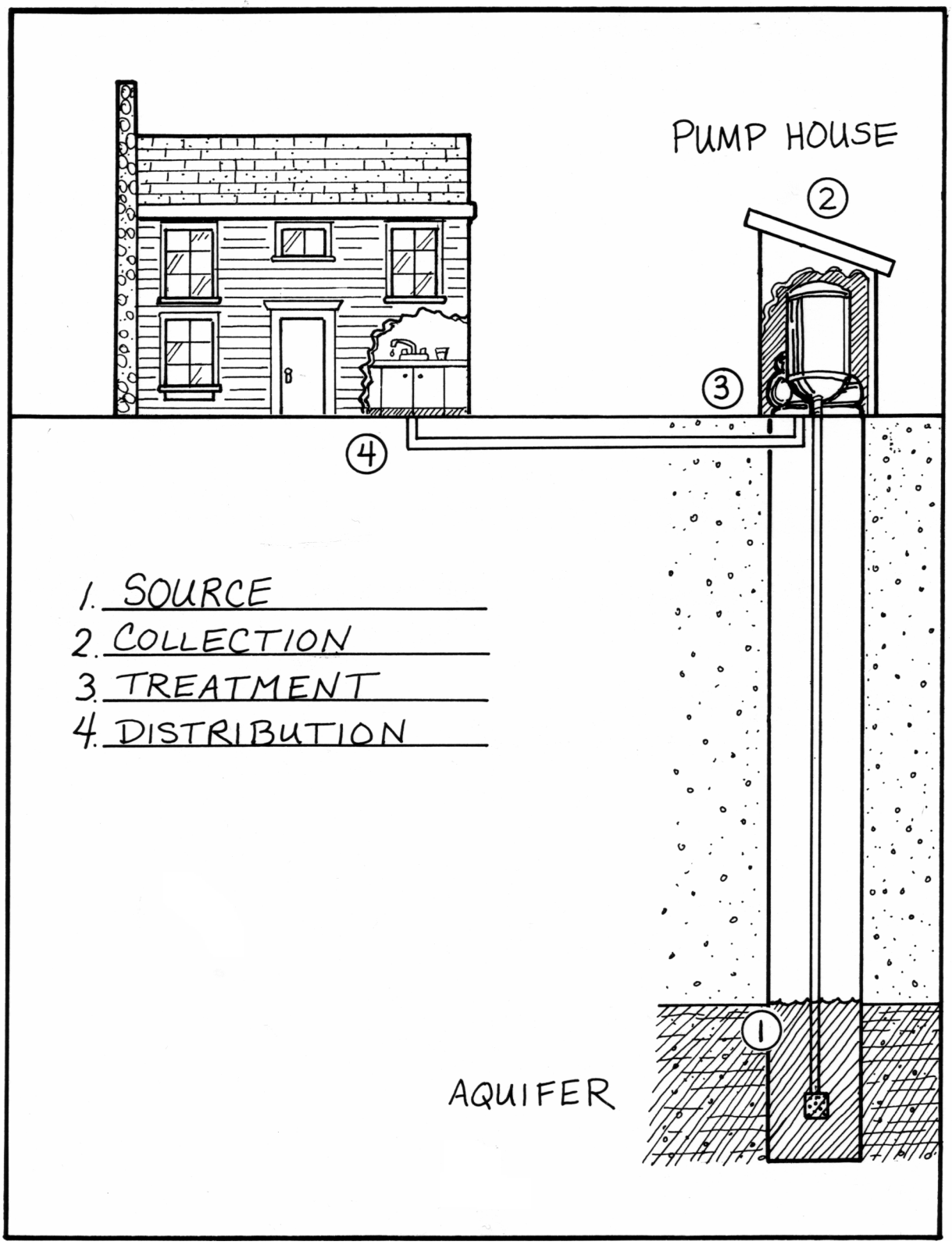




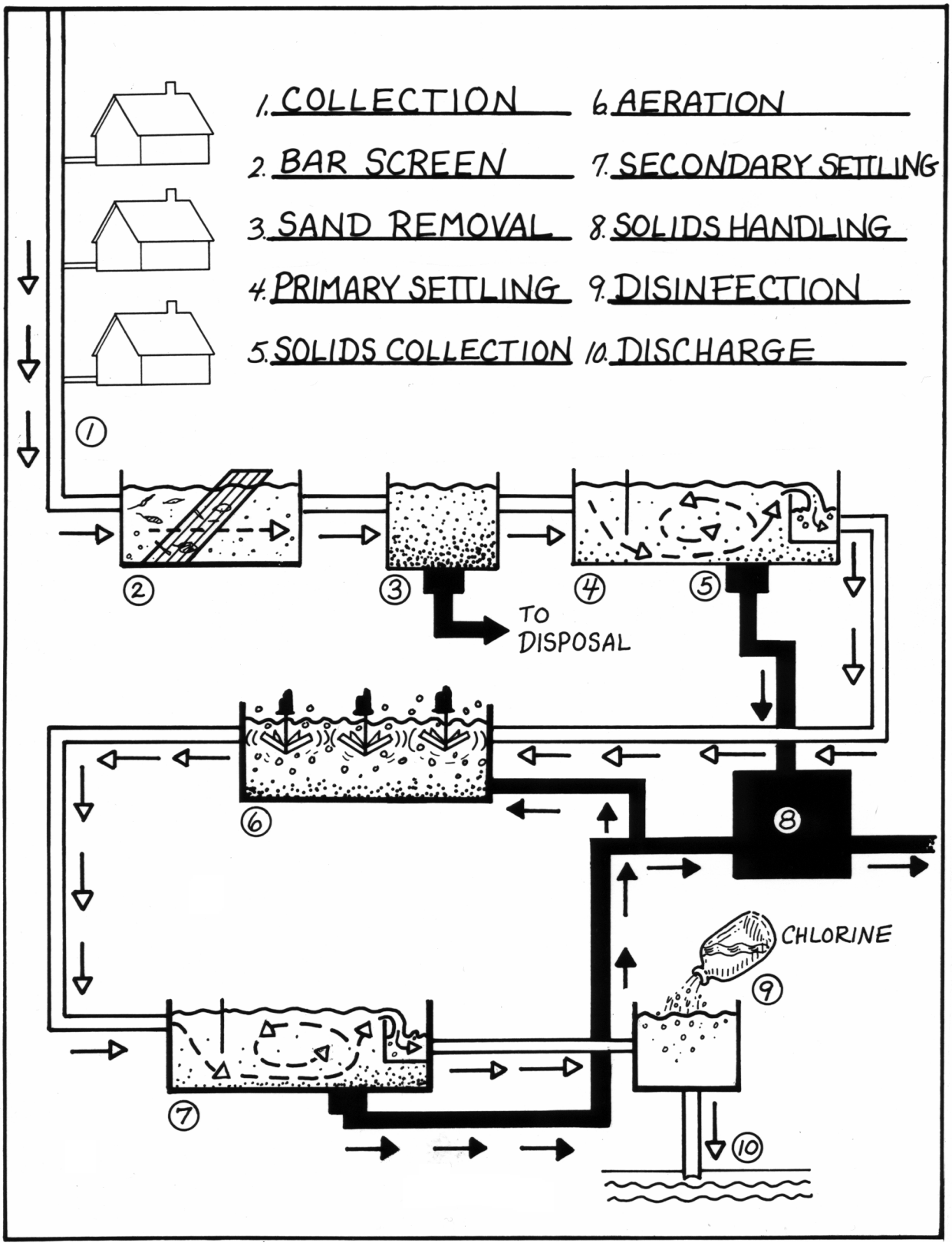
DRINKING WATER TREATMENT PLANT

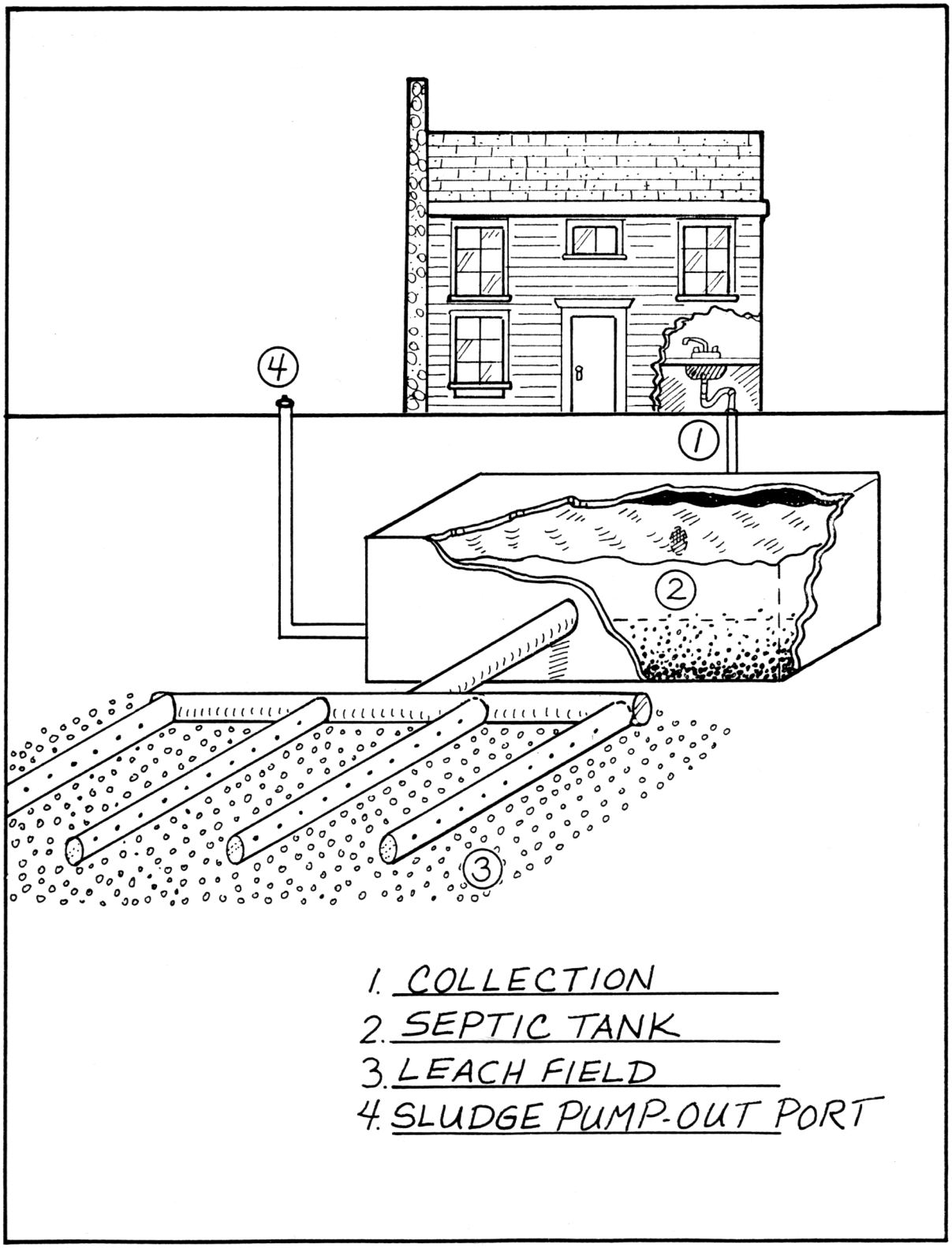
Teacher Sheet




PUMP HOUSE
2
3
4
1
1. SOURCE
2. COLLECTION
3. TREATMENT
4. DISTRIBUTION
AQUIFER

WASTEWATER TREATMENT PLANT




4
1
2
3
1. COLLECTION
2. SEPTIC TANK
3. LEACH FIELD
4. SLUDGE PUMP-OUT PORT

HOME SURVEY

Name_____ Date_____

Dear parent/guardian:
Our class is learning about the source and treatment of our drinking water supply and the disposal of our wastewater. Please take a few minutes to help your child answer the following questions to the best of your knowledge.

1. Is your water supplied by a water company? yes / no (If no, skip to question 2.)

   a. Is it treated with chlorine? yes / no

   b. Is it treated with fluoride? yes / no

2. If you have well water...

   a. Where is the well located on your property? _____

   b. How old is your well? _____

   c. How deep is it? _____

   d. Is your well water treated with any chemicals? yes / no What kind? _____

   e. Does your well have a filtering system? yes / no What kind? _____

   f. Have you ever had your well water tested? yes / no

3. Are you served by a sewer system? yes / no (If "no," skip to question 4.)

   a. Where is the wastewater treatment plant located? _____

   b. What river or stream receives the treated wastewater from the treatment plant? _____

4. Where on your property is your septic tank located? _____

   a. How many gallons does it hold? _____

   b. How old is it? _____

   c. How extensive is the tank's drainfield? _____

   d. What problems, if any, have you had with your septic tank and drainfield? _____

   _____

   _____

Thanks so much for your help!

WATER'S JOURNEY

OBJECTIVES

The student will do the following:

1. Demonstrate the cycle of water through a community.
2. Become aware of the uses of water in their community.
3. Recognize the need for water conservation in their community.

SUBJECTS:
Science, Social Studies, Art

TIME:
120 minutes

MATERIALS:
bulletin board
butcher paper or art pad
milk cartons (pints, quarts)
small boxes
markers
scissors
pictures cut from magazines
construction paper
masking tape, push pins, or thumb tacks
posterboard
crayons
acetate sheet
overhead projector
teacher sheets (included)
bell or buzzer (optional)

BACKGROUND INFORMATION

You may be surprised to know that you use the same water over and over again. The water you swam in last week may be the water you will drink today. The water that comes from the lake where you swim may be pumped to your local water treatment plant. Here, the water is treated (cleaned) and then it goes to your home where you will drink it, take a bath in it, or maybe water your plants. After you use water, it goes down the drain and travels to a wastewater treatment plant, where it is cleaned and put out into a lake or river.

Think of your water as if it is taking a journey. The next time you turn on your faucet you will have an idea of how far your water has come and where it is going. This is similar in concept to the natural hydrologic, or water, cycle in which water "travels" through various states of matter and parts of the natural environment. A community water cycle might be thought of as the human world's version of the natural water cycle.

Terms

conserve: to use a resource wisely and efficiently.

cycle: a process that repeats itself.

resource: a supply of a valuable and useful thing.

ADVANCE PREPARATION

A. Gather materials for bulletin board (butcher paper to cover bulletin board, construction paper, markers, milk cartons for buildings, and pictures). If you are going to make the "3-D" bulletin board illustrated, gather small boxes (such as gift boxes, small food boxes [e.g., cereal, cookies, etc.], and small milk cartons) and cut off the bottom of each one (so you can reach into it to mount it with a thumb tack).

B. Make a transparency of the "Community Water Cycle" teacher sheet.

PROCEDURE

I. Setting the stage

A. Ask the students the following questions.

1. What is a community? (a group of people living together in a designated area) Review social studies community concepts with the students. Remind them that an important part of any community is the services and utilities that provide the things people need.

2. What is a cycle? (a complete process that repeats itself; the seasons of the year are a good example)

3. Can you describe a community water cycle? (a water distribution process that repeats itself through a community) Show the students a transparency of the "Community Water Cycle" teacher sheet.

B. How could we illustrate a community water cycle? Lead the students into developing a bulletin board.

II. Activity

A. Develop a bulletin board that represents a community water cycle. See the teacher sheet, "Community Water Cycle Bulletin Board," for a diagram of a bulletin board. Introduce the students to how a water utility serves the community (keeping a supply of safe drinking water, making sure water is safe from diseases, treating wastewater so it may safely be discharged).

B. Divide the students into teams.

1. Instruct one team to cover the bulletin board with butcher paper and draw or cut a "stream" from construction paper; this represents the source of water. Title the board "Water's Journey."

2. Have the other teams draw buildings and cut them out, or use magazine pictures, or small milk cartons and boxes decorated as buildings to represent the homes, schools, businesses, and other buildings that would be present in a community.

3. Then have the students place these "buildings" on the board to represent the distribution and use of water in a community. (Mount them with thumb tacks or push pins. You could staple them or try rolled pieces of masking tape to mount the cartons.)

C. Together with all of the students, construct or draw buildings to represent the water treatment facility and the wastewater treatment plant to show that water is treated (cleaned) before it is used and again

after it is used, then returned to the stream.

III. Follow-Up

A. Ask the students to think of as many ways as possible that their community uses water. (residential – bathing, cooking, washing; industrial – factories; commercial – hospitals, businesses, and restaurants; habitat for wildlife; agriculture; public use) List these on the board or on an overhead projector.

1. Divide all the listed uses into two groups:

a. essential (drinking, bathing, flushing, cooking)

b. non-essential (watering lawn, washing car)

2. Discuss listings in the non-essential group and consider what each student can do to conserve water.

3. Would it be difficult to bring about change in community water use? Discuss this question with the students.

4. Who do the students think they should contact concerning changes in water conservation at the community level? (begin by contacting the water utility)

B. Have students or teams of students design posters reminding people to conserve water. (Post these in the hallways of school, in the community library, and in businesses.)

IV. Extensions

A. Ask the students or teams of students to write a commercial to encourage people in the community to conserve water.

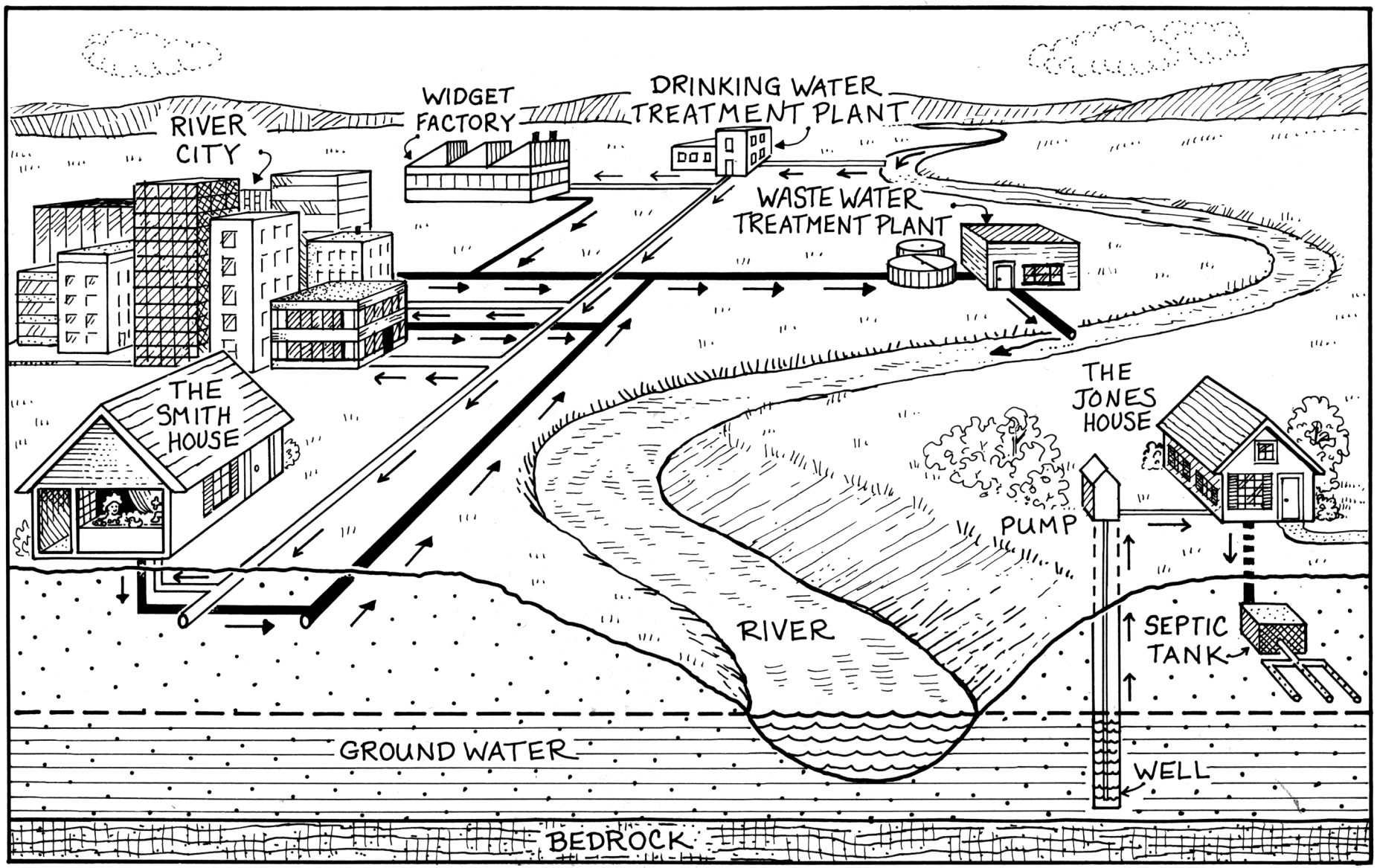
B. Ask someone from the Agricultural Extension office to come in to speak to your students.

RESOURCE

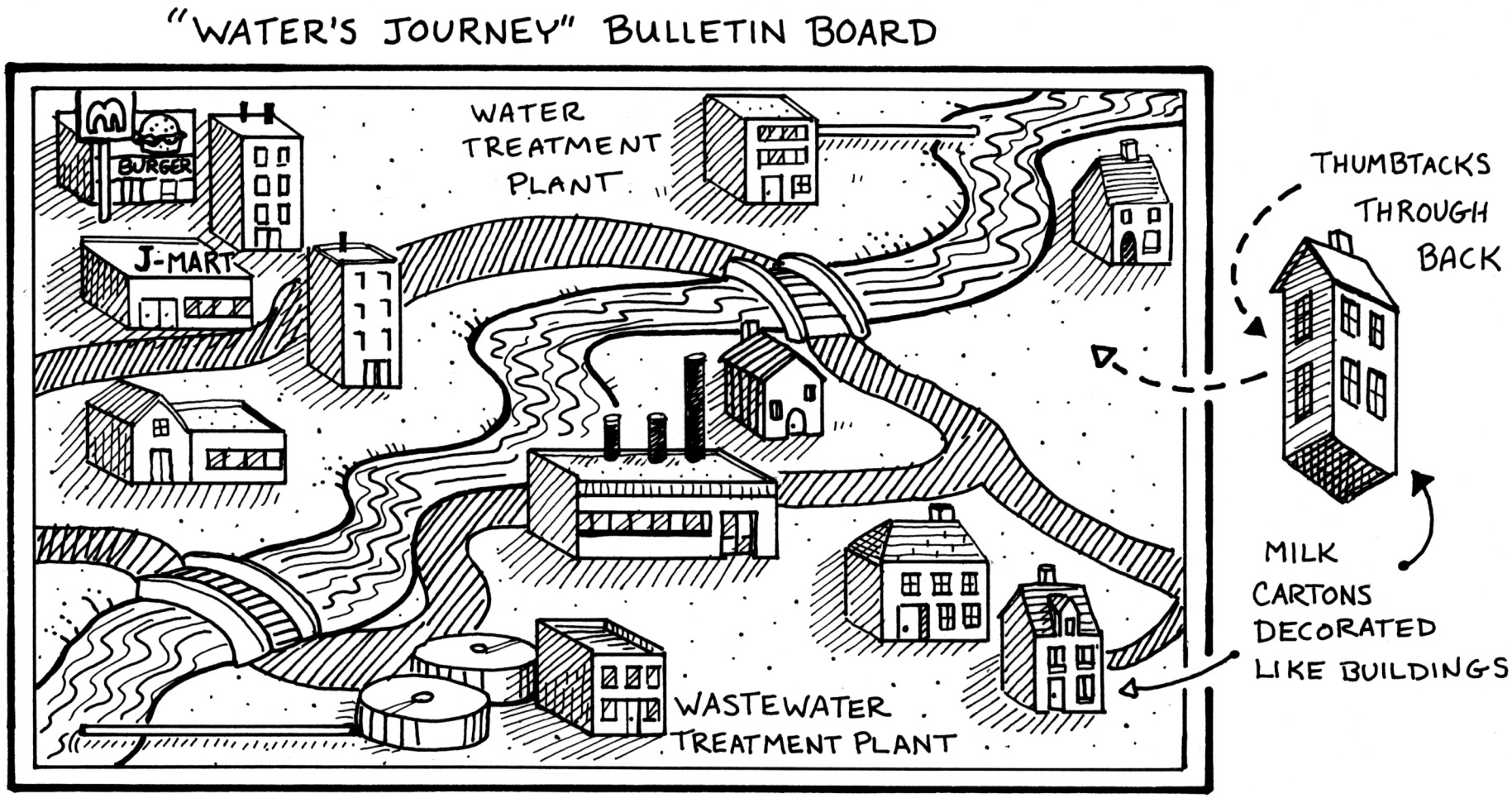
"The Story of Drinking Water" (student booklet), American Water Works Association, Denver, Colorado, 1984.

COMMUNITY WATER CYCLE

Teacher Sheet



COMMUNITY WATER CYCLE BULLETIN BOARD



SAVING A RESOURCE IN JEOPARDY

OBJECTIVES

The student will do the following:

1. Name many uses of water.
2. Classify water uses into four main categories.
3. Learn water conservation habits.

SUBJECTS:
Science, Social Studies, Language Arts, Math

TIME:
60 minutes

MATERIALS:
chalkboard
16 sheets of scrap paper
tape
marker
play money in 4 denominations
camcorder and video tape (optional)
clipboard
list of student's names for each teacher
teacher sheet (included)
bell or buzzer (one per team)

BACKGROUND INFORMATION

Water conservation saves energy, money, chemicals and fresh water supply. It takes a lot of energy to pump water to your home and, once it gets there, it takes both energy and money to heat water. Heating water is usually the second largest use of energy in the home. Everyone who uses water spends money for that privilege (both city water pumped to your house, school, office, recreational facility, etc., and well water—you pay to install a well). Chemicals are used at water treatment plants.

Communities face two problems. One is the increasing demand for clean water. The other is locating new water sources. The water we use often comes from underground reserves. If we use this water faster than nature can replace it, sometimes the land sinks. According to the U.S. Geological Survey, 35 states are pumping groundwater faster than it is being replaced. We are using the earth's water supply from hundreds of millions of years ago. In the water cycle it is used over and over again. We need to keep it clean and conserve it to make sure there is enough fresh water to meet our future needs.

Term

conservation: to protect from loss or depletion

ADVANCE PREPARATION

A. On the 16 sheets of typing paper, write $1 on 4 pieces, $5 on 4, $10 on 4, and $20 on 4 with a big magic marker. (Also, make the gameboard on posterboard if you won't be using a chalkboard.)

B. Get play money in a variety store's party supply section. (NOTE: Make sure the denominations on the typing paper sheets correspond with the play money denominations.)

PROCEDURE

I. Setting the stage

Have the students brainstorm as many uses of water they can possibly think of. Write these on the board. Next ask them to see if there are any similarities. Can they put these words in groups? Have the students suggest categories for the water uses they listed. Work on this as a class, and lead the students to use residential, agricultural/rural, industrial, and recreational as the categories.

II. Activity

Have the students play the Water Conservation Jeopardy Game.

A. Use a chalkboard to set up the categories like they do on television. On the chalkboard write the appropriate answers which are found on the teacher sheet, "Water Conservation Jeopardy Game." (For your benefit, the correct response [question] is underlined.) Cover the questions with pieces of paper with dollar amounts on them and pull them off to reveal the questions. When a team/individual gets a right answer on the first try, hand them a piece of play money.

Set up a chalkboard like this.

Residential	Agricultural	Industrial	Recreational
$1	$1	$1	$1
$5	$5	$5	$5
$10	$10	$10	$10
$20	$20	$20	$20

(NOTE: If you prefer, you may make a reusable chart on which to play this game. Also, if you cannot put the cover sheets on your chalkboard with small pieces of tape, use a bulletin board for your gameboard.)

B. Play the game in teams of boys vs. girls, blue-eyed vs. brown-eyed, type of shoe, or what they ate for breakfast or just divide the groups alphabetically. Each team must choose a spokesperson to give the answer for their team. The first team to answer correctly gets the play money and the right to choose the next question. Play the game as they do on TV. Have the team ring a bell or press a buzzer when they have the correct answer. When a team asks, for example, for Recreational $10, pull the sheet of paper away from that area and ask the team the appropriate question. (NOTE: The answers are constructed so that students can guess the correct answers if they think about them.)

III. Follow-Up

Have the students write a paragraph about "what they learned" from this activity. Ask them to state their favorite water conservation fact and the reasons they thought this was the most interesting.

IV. Extensions

A. Have the students read one of Wilder's Little House books (or read to them) or some similar book. Let them make the following comparisons:

Past	Present
_____	Turn on the faucet
_____	Bathe in the bathroom
_____	Hot water comes from a water heater
_____	Flush the toilet in the bathroom
_____	Pull the plug in the bathtub after a bath

B. Students can make a study of inventions and make a time line. Make a list of inventions/devices that have to do with the use of water. If you have the resources, find out when products concerning water were invented/patented and draw these on a time line. (Check on the bathtub, PVC pipe to get water to our homes, hot water heater, faucets, and tea kettle.)

C. For a creative writing/acting activity, have students work in cooperative learning groups. Each group is to create a play/skit/pantomime (their choice) to show how water can be conserved in these four areas—residential, agricultural/rural, industrial, recreational. They need a title for it when they finish. Encourage background music and/or "speaking parts." After composing the script or actions, videotape their rehearsal. Let them play back the tape and critique it for changes before they do the "real" thing for other classes or the PTA.

D. To incorporate math, conservation, and phone book skills, try the following activity.

1. Find the water meter in your school. Take a reading at the beginning and end of the day. If your school gets water from a utility company or city, call the water department.

2. Teach telephone book skills. Blue pages are government pages. Four sections (city, county/parish, state, national) exist. Find out how much 1 gallon of water costs your school. Call the central office for your school district and find out how much water your school uses in a certain month and how much it costs.

3. Have children devise a way to "catch" the water that is wasted by your school in (any time segment you think is appropriate) by students not turning off the faucet completely. How much money do you waste in one day, one month, the whole school year? How much money could you SAVE?

E. Have the students act as undercover water cops to encourage water conservation.

1. Each time students go to the bathroom, drink from a fountain, or use classroom sinks, have them take note of times students do not turn the water faucets completely off, or who run more water than they need.

2. At the end of the day, add all the students' lists (tallies) together for a count of the instances of wasting water.

3. Have the class make a list of the ways they can conserve water at school.

F. If your class has pen pals, write to them and ask them how much water costs in their city. If they don't have pen pals, let each child write to another city in the United States to find out what other people pay for water. (Addresses can be found in the World Almanac and telephone directories in public libraries.) Make a graph. Discuss why it would be different in different parts of the country.

RESOURCES

Miller, G. T., Environmental Science: Sustaining the Earth, Wadsworth, Belmont, California, 1991.

1991 Statistical Abstract, U.S. Department of Commerce, p. 239.

"The Official Captain Hydro" (Water Conservation Workbook), East Bay Municipal Utility District, Oakland, California, 1982.

Wilder, Little House books (various).

Teacher Sheet

WATER CONSERVATION JEOPARDY GAME

Residential

$1 What two resources do you save by taking shorter showers? (Water/Energy, Water/Trees, Water/Air)

$5 If you wash your dishes with the tap running, how many gallons of water could you use? (5 gal./15 gal./30 gal.) (NOTE: About 5 gallons are used if you use a dish pan to hold the water.)

$10 How much more water do you use if you leave the water running while you brush your teeth? (2X/10X/100X) (NOTE: If you just wet the toothbrush and rinse it you only use about 1/2 gallon.)

$20 How many gallons of water do you use when you flush a standard toilet? (1 quart, 1 gallon, 5 gallons)

Recreational

$1 What do most people do "in" water? (fish, swim, brush teeth)

$5 Hockey is a team game played on a surface covered with water in which of these states? (solid, liquid, gas)

$10 Name two water sports that require a sail. (think) Team has to come up with 2. (Possible answers: sailing/wind surfing/parasailing.)

$20 In 1990 how much money was spent on buying pleasure boats? ($9 million, $9 billion, $9 trillion)

Industrial

$1 About how much does one U.S. gallon of water weigh? (2 lbs./8 lbs./108 lbs.)

$5 Do Canadian and U.S. gallons weigh the same? (yes/no) (NOTE: Canadian imperial gallon weighs 10 lbs.)

$10 Which of the following accounts for more of industry water use? (washing things, cooling things that get hot, mixing into things)

$20 About how many gallons of water were used for industrial purposes in 1985? (2 million, 2 billion, 29 billion) (Extra: Can anyone write this big number on the board? $29,000,000,000)

Agricultural

$1 If a farmer is irrigating on his farm, what is he/she using water for? (plants, animals, cleaning)

$5 If a rancher is watering his livestock, what is he doing? (watering his crops, washing out the barn, giving his animals a drink)

$10 About how much of our fresh water is used for agriculture? (10%, 20%, 40%)

$20 In the United States which of the following uses more of our water? (cities, industries, agriculture)

WHAT A WATER JOB!

OBJECTIVES

The student will do the following:

1. Know what makes a career water-related.
2. Discover careers of interest.
3. Identify information on the careers of their choice.

SUBJECTS:
Science, Language Arts, Art, Social Studies

TIME:
180 minutes

MATERIALS:
acetate sheet
overhead projector
yarn
coat hangers
index cards
paper punch
paste or glue sticks
construction paper
markers or crayons
butcher or other large paper
student sheets (included)
teacher sheets (included)
prizes (optional)

BACKGROUND INFORMATION

The area of water and related sciences, industries, and trades offers many career options. The expertise involved varies from on-the-job training to a doctorate in a water specialty. Each is important – from the plumber to the marine geophysicist. Some careers also offer recreational benefits, such as professional skiing and underwater photography. While we have many science fields involving water, we equally need tradesmen in water careers. Perhaps a water career will be of interest to your students.

Terms

career: a job one trains to do.

related: having a connection, going together.

water: a necessity for life on earth; found on the surface and under the ground.

ADVANCE PREPARATION

A. Make a transparency from the teacher sheet, “Water-Related Careers.”

B. Make copies of the student sheet, “Student Interest Inventory” if needed.

C. Make copies of teacher sheet, “Fact Flash Cards,” and cut them out. You will need one card per student. Punch a hole at the top of each one. Cut yarn in various lengths (eight inches and less).

D. Make copies of teacher sheet “Water Certificate” and fill them out for your students.

E. If you are going to hold a Water Day Festival, plan your activities now. Make copies of parent/ student sheet "Water Day Festival Announcement."

PROCEDURE

I. Setting the stage

Discuss the definition of water and how a career could be water-related. Ask students to name careers they think are water-related; list them on the board. Use a transparency of the teacher sheet, "Water-Related Careers," for additional water-related careers. Many of the careers listed will be unfamiliar to the students; tell them they will be investigating some of these.

II. Activity

A. Have each student write down a career that he/she is interested in and have them select four others, including two with which they are not familiar; they will research these. You might use an interest inventory to assign jobs. (NOTE: The student sheet, "Student Interest Inventory," might be helpful. You might also divide the students into small groups that can work together, rather than having individual students working alone.)

1. Each student will be responsible to find facts on 5 careers.

a. Information can be researched in the library using reference materials such as encyclopedias or books about appropriate topics. Ask your librarian to help your class by pulling a collection of books and magazines with the appropriate information..

b. If students know someone in a selected career they can interview that person. Information gained during an interview can be included on the flash cards students will make.

2. Give each student five fact flash cards (or blank index cards). Have students list at least 5 facts on one side and draw an illustration on the opposite side.

a. Use a piece of yarn to attach five flash cards to a coat hanger. Each card will have a different length of yarn to hang it with.

b. Place a piece of construction paper at the top of the hanger and label it "Water Jobs." Hang these career mobiles around the classroom.

B. Students will play a "stand-up" game.

1. Have them select their favorite career and write 5 clues for it. On the day your class plays "What's My Water Job?" they can bring in props such as a hat or instrument associated with that career.

2. When it is their turn students will stand up and, using their props, they will give one clue at a time.

a. Their classmates will guess their profession.

b. The student who guesses correctly receives points. The points correspond with how many

clues they had (1 clue = 5 points, 2 clues = 4 points, 3 clues = 3 points, 4 clues = 2 points, 5 clues = 1 point).

3. At the end of the game the student with the greatest number of points receives a prize (such as a water toy, or a bottled water drink). A certificate made from the teacher sheet, "Water Certificate" could be given to the winners.

III. Follow-Up

Celebrate with "Water Day." Pick a day and plan water activities for the students. A warm day would be best for these activities.

A. Invite guest speakers that have water-related careers. (See the listing on the student sheet for ideas, and check the parent volunteer you get when you send the announcements home.)

B. Use the parent/student sheet, "Water Day Festival Announcement" to announce your festival.

C. Make posters of 5-foot humans (have students trace each other on butcher paper). Dress them for water-related careers. Decorate the halls with these career-minded paper dolls.

D. Students may make and display science or social studies projects involving water topics.

E. Have the lunchroom plan a meal and list the amount of water in each item on that day.

F. Play games outside like water balloon relay races or tosses, (clean) spray bottle squirt games, or building toy boats (e.g., from aluminum foil) and racing them in a wading pool. You may also hold taste tests for various bottled waters or have carnival games like a water version of "Go Fish."

IV. Extensions

A. Have students make a flag or banner for a water-related career. Use paper or cloth and attach to sticks or to dowel rods. Hang them up in your classroom.

B. Take the flash cards and play a game. Have the students work in small groups of 3 or 4 to create their games. Have them write down the rules for their game. Spend a class period and allow them to play the games they created.

C. Have students write letters to people in the water-related career of their choice.

D. Make a large group painting (a mural) using magazine pictures and original drawings. Water- related careers will be illustrated in the mural. Display in a visible place.

E. Play "Water Job Baseball," using the flash cards. Set the classroom up in standard baseball formation. Place a chair on each base and one for the pitcher. Divide the class into 2 teams. As each student comes up to bat a flash card is used to ask a question. Four clues without a response is an out. If they answer correctly they run (four clues=first base; 3 clues=second base; 2 clues=third base; 1 clue=HOME RUN). The team with the most runs is the winner. Change teams when one receives 3 outs.

Student Sheet

WATER-RELATED CAREERS

boater
seaman
yachtsman
motor sailboater
plumber
water meter reader
wastewater treatment engineer
merchant marine
professional skier (water or snow)
ice skater
professional tournament fisherman
Coast Guard
Navy
submariner
water level controller
biosolids specialist
environmental chemist
water line installer
oceanographer
marine conservationist
underwater photographer
science teacher
snow hydrologist
meteorologist
marine geophysicist
marine geologist
limnologist
hydrologist
marine technician
groundwater contractor
health department environmental inspector
aundry attendant
lifeguard
scuba diver
aquarium director
bottled water company employee
desalination plant director
diver
fireman
landscape artist
potter
scuba instructor
Olympic/professional swimmer
recreation instructor
rafting guide
marine explorer
sunken treasure hunter
marine salvage engineer
water quality control officer
marine biologist
tugboat captain
boat builder
commercial fisherman
well driller

STUDENT INTEREST INVENTORY

1. When you grow up what job would you like? _____

   _____

2. What water sport do you like best? _____

   _____

3. Can you think of a job that involves working with water? Do you want to know more about it? What is that job? _____

   _____

4. Do you have any hobbies? Tell me about them. _____

   _____

5. What are some fun things you do with your family? _____

   _____

6. What are the titles of your favorite books? _____

   _____

7. What are the names of your favorite television shows? _____

   _____

8. What are the names of your favorite games? _____

   _____

9. What are your favorite subjects in school? _____

   _____

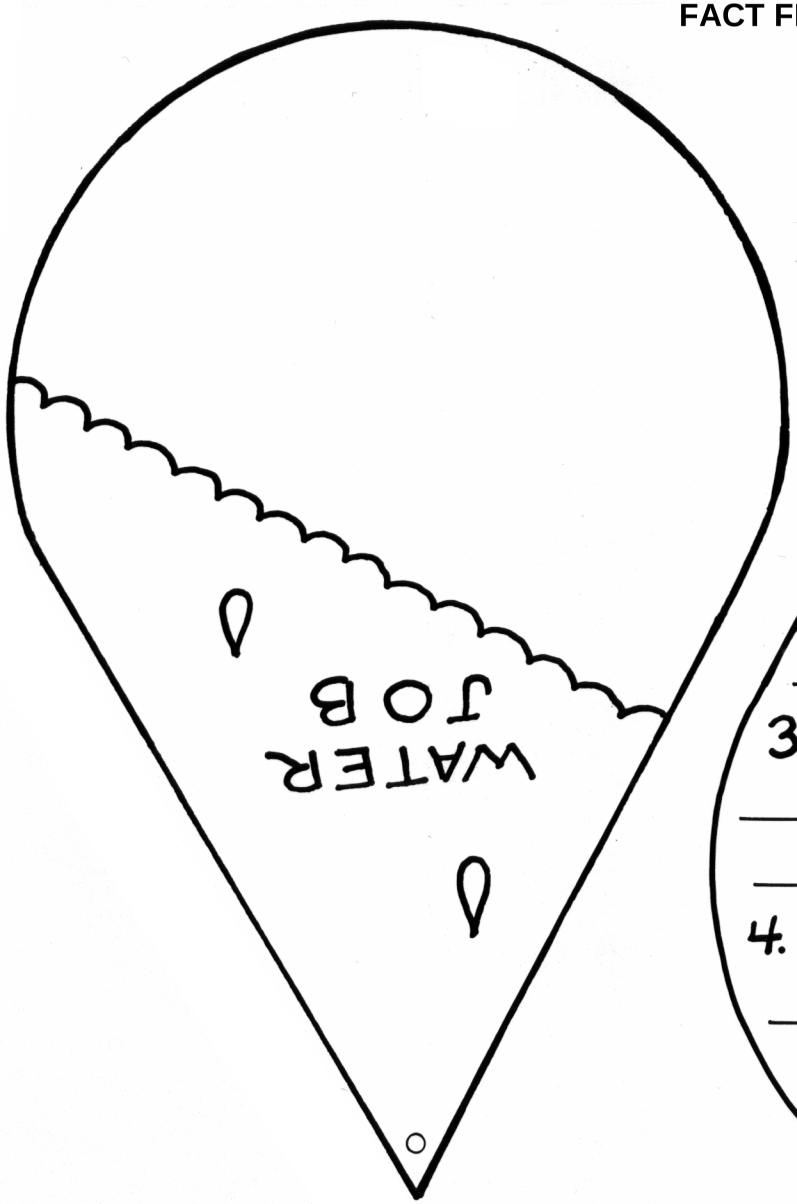
10. What are three interesting things you can tell me about you? _____

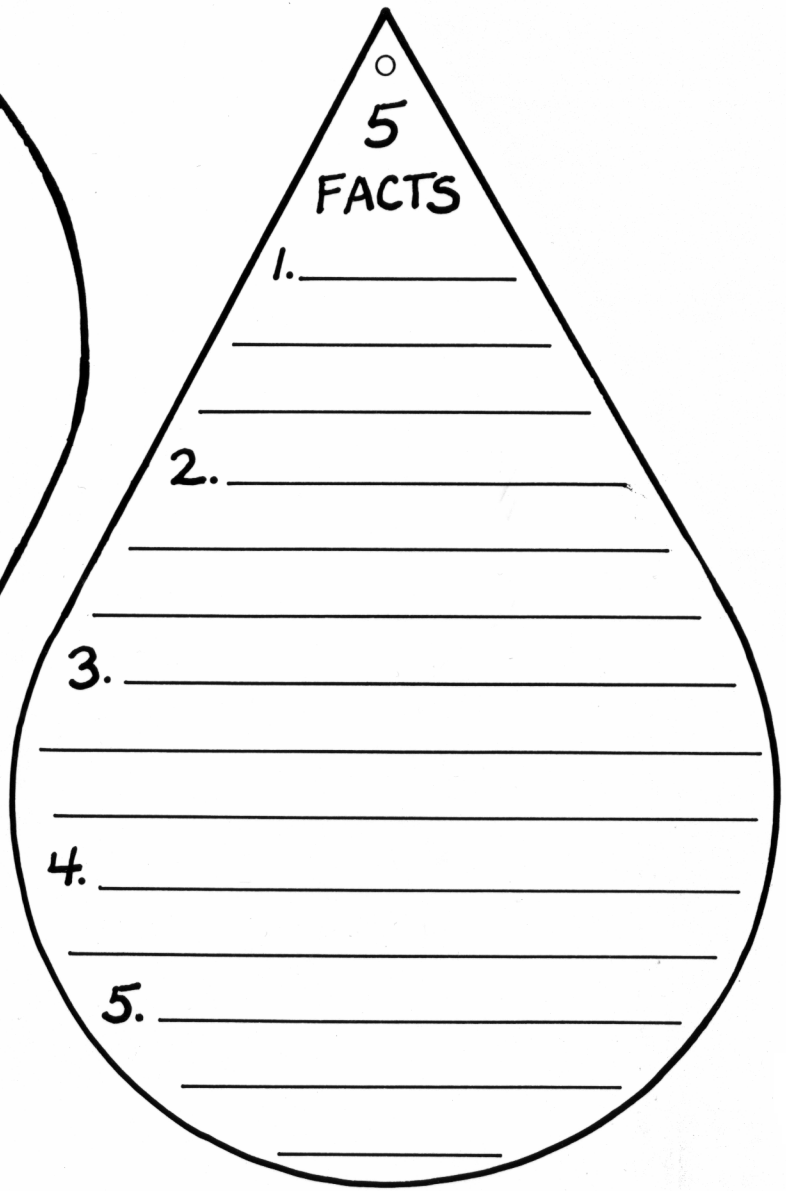
    _____

Parent/Student Sheet

FACT FLASH CARDS

Teacher Sheet





Certificate

FOR

KNOWLEDGE OF WATER CAREERS

AWARDED TO

NAME _____ DATE

WATER DAY FESTIVAL ANNOUNCEMENT

WHO:

WHAT:

WHERE:

WHEN:

DEAR _____,

_____ SCHOOL WILL CELEBRATE A WATER DAY FESTIVAL ON _____. WE NEED GUEST SPEAKERS TO SHARE WHAT THEY DO IN THEIR WATER JOB. IF YOU OR A FRIEND HAVE A CAREER IN WATER, WE WOULD LIKE TO HEAR FROM YOU. WE CAN USE VOLUNTEERS IN OTHER ACTIVITIES— OR SHARE IN THE FUN! IF YOU CAN HELP US IN ANY WAY IT WILL BE APPRECIATED. THANK YOU!

MY CHILD'S NAME IS: _____

_____

MY WATER RELATED JOB IS: _____

I CAN HELP WITH THE WATER DAY FESTIVAL.

_____

OTHER: _____

SIGN: _____