GET THE SALT OUT!

OBJECTIVES

The student will do the following:

1. Demonstrate that salt water can be changed to fresh water by evaporation (desalination).
2. Make and use a hydrometer to measure the density (saltiness) of water.
3. Research places in the world where desalinated water is the main source of drinking water.

SUBJECTS:
Science, Geography

TIME:
2 45-minute periods

MATERIALS:
world map
5 clear drinking straws
1/4 lb (100 g) clay
20 to 30 steel BB's
tap water
permanent ink pen
metric rulers
3 samples of liquids
3 clear glass quart jars
student sheet (included)
table-tennis ball
golf ball
clear plastic pitcher
mixing spoon
duct tape
2 glasses of water
teacher sheet (included)
two 2-liter bottles
black paint
12 inches (30 cm) of clear plastic tubing (as for aquarium)
aluminum foil
salt
small (bathroom) paper cups (1 per student)

BACKGROUND INFORMATION

Salt water makes up 97 percent of all the water on the earth. Though abundant, salt water is not potable, or fit to drink.

Fresh water can be obtained from salt water by a process called desalination. There are several ways to desalinate salt water: evaporation, reverse osmosis, membrane electrolysis, and freezing. The least expensive of these methods is usually evaporation.

Desalination is seen as a solution to fresh water shortages by some people, but the energy requirements of these procedures cause desalinated water to be very expensive. Desalinated water costs six times as much per unit as fresh water.

As of 1985 about 600 desalination plants around the world produced approximately 250 million gallons (947 million L) of fresh water per day. That is only 0.4 percent of the U.S.'s daily water use and 0.006 percent of the world's daily water use.

A hydrometer is a device used to measure the density of liquids such as salt water. The higher a hydrometer floats in a liquid, the more dense or salty the liquid is.

Terms

density: a measure of mass per unit of volume of a substance.

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

evaporation: the process by which liquid water becomes vapor in the atmosphere.

hydrometer: a device that measures the density of water.

ADVANCE PREPARATION

A. Copy student sheet.

B. Thoroughly clean the two 2-L bottles. Paint one of them black.

C Obtain the clear tubing from any store selling aquarium supplies. Wash it out well.

D. Mix the following solutions in clear jars and label: 1) 2 tablespoons (30 mL) salt in 3/4 quart (750 mL) water, A; 2) 4 tablespoons (60 mL) salt in 3/4 quart (750 mL) water, B; and 3) 6 tablespoons (90 mL) salt in 3/4 quart (750 mL) water, C.

E. Prepare 2 glasses of water, one labeled as tap water with a price of 1 cent (A) and one labeled as desalinated water with a price of 6 cents (B).

F. Fill clear plastic pitcher with water.

PROCEDURE

I. Setting the stage

A. Display a map of the world and the two labeled glasses of water at the front of the room.

1. Discuss with the class the availability of water. Ask the following questions:

a. Do you ever run out of water at your house? (no; except for unusual, and typically short-term, situations)

b. Can you name a place on earth where people might run out of water to drink? (the desert)

c. Can you drink sea water? Why not? (No, it's too salty.)

d. Can you change sea water to make it drinkable? (Accept all answers. Then explain that sea water can be made drinkable.)

2. Point out Saudi Arabia on the map and explain to the class that in this region of the world people must get their water from the sea.

a. Hold up the two glasses of water and ask, "Who would like to buy a glass of water? Glass A costs 1 cent and glass B costs 6 cents."

b. Explain that water in Saudi Arabia costs six times as much as water in the U. S.

B. Write the word desalination and its definition on the board.

1. Explain that the Saudi water is desalinated sea water and that is why it costs six times as much as ours.

2. Tell the students that you will demonstrate how to desalinate water by the process of evaporation. See the diagram on the teacher sheet "desalination."

3. Add 2 tablespoons (30 mL) salt to the fresh water in the clear 2-liter plastic bottle and mix.

4. Pour the salt water into the black 2-liter bottle.

5. Attach the clear tubing to the black bottle and the clear bottle. Seal with duct tape.

6. Set both bottles in a sunny window with the black bottle 3 to 4 inches higher than the clear bottle.

II. Activity

A. Hold up a golf ball and a table-tennis ball. Ask the following questions:

1. Which ball is denser?

2. Which ball will float?

B. Write "density" and its definition on the board. Explain that the golf ball is denser than the table-tennis ball because the golf ball is solid, while the table-tennis ball is hollow.

C. Divide the students into teams of 5 each.

1. Pass out the student sheets on the hydrometer.

2. Write "hydrometer" and its definition on the board.

3. Explain that each team will make a hydrometer to test the density of three different liquids.

4. Have one student from each team pick up all the materials needed to make the hydrometer (listed on the student sheet "Hydrometer").

5. Students will follow the directions on the student sheet through Step 5 to complete the hydrometer. If hydrometers do not float, it is probably because the students have used too much clay. They should remove some of the clay and try again. (NOTE: For third grade, you may lead the groups step by step through the process.)

D. Groups will come up one at a time to the testing table to test the density of solutions A, B, and C.

1. Each team will record the results of their test.

2. Teams will answer the questions under observations and conclusions. (NOTE: This section may be done as a teacher-led discussion. The results should show that A is the least dense salt water, B has medium density, and C is the most dense. Tap water should prove to be even less dense than A.)

III. Follow-Up

After an observable amount of water has collected in the clear bottle from the desalination demonstration, pour water into cups from the black and clear 2-liter bottles. Have students taste each by giving each student a small paper cup and dispensing to each a very small taste from each of the two bottles. (NOTE: Remind the students never to taste anything used in an experiment unless it is a safe substance and they are specifically directed to taste it.) Was there a difference? (Water from the black bottle is salty tasting and water from the clear container is not salty.)

IV. Extensions

A. Allow the desalination demonstration to continue until enough water has collected in the clear bottle to test the density of it. Compare its density to the density of the water in the black bottle.

B. Have the students choose several countries they believe would use desalinated water and research whether those nations have desalination plants to provide drinking water.

C. Freeze salt water to separate the salt and water.

D. Try to float an egg in salt water and in tap water as another way to show their comparative densities.

RESOURCES

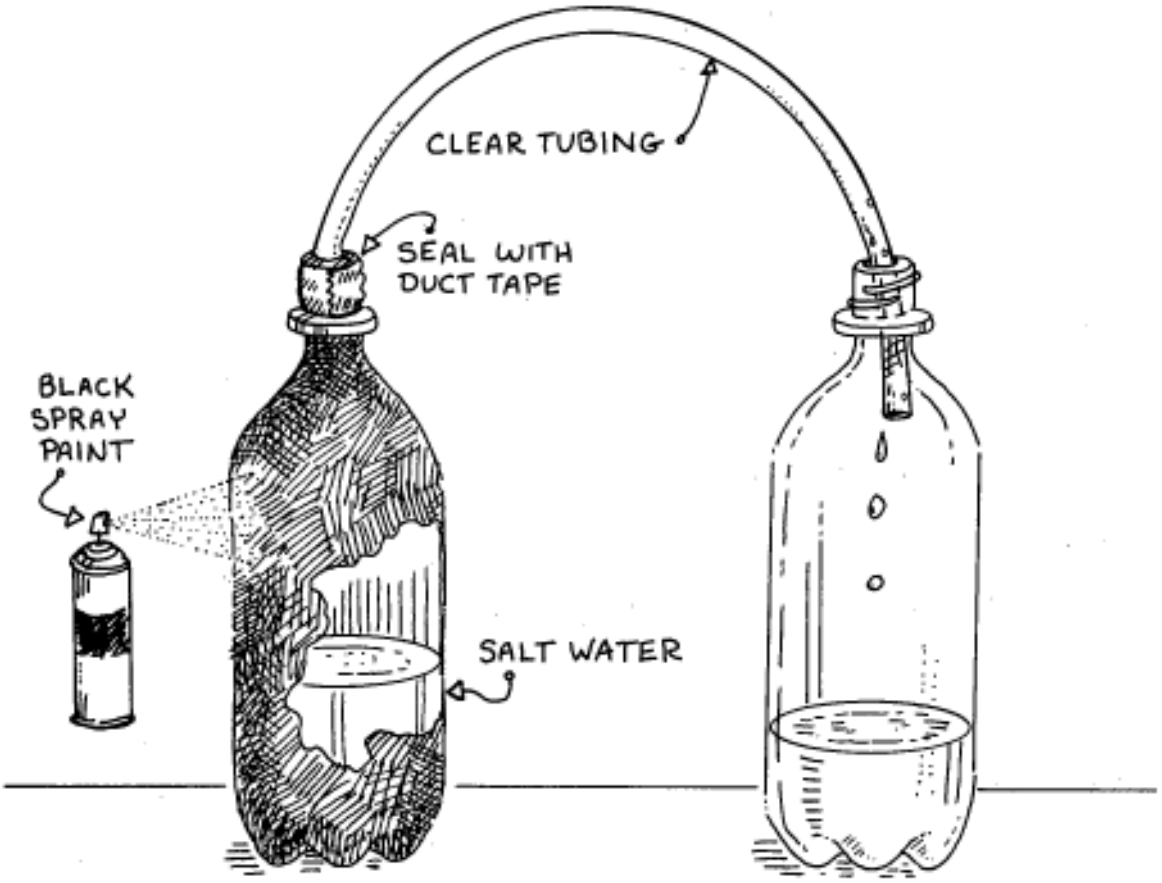
Handwerker, Mark, et al., Earth Science, Harcourt Brace Javanovich, Inc., Orlando, Florida, 1989.

Hurd, Dean, et al, General Science: A Voyage of Adventure, Prentice-Hall, Englewood Cliffs, New Jersey, 1989. (Laboratory activity adapted from p. 518.)

Miller, Tyler G., Environmental Science: An Introduction, Wadsworth Publishing Co., Belmont, California, 1986.

Miller, Tyler G., Living in the Environment: Concepts, Problems, and Alternatives, Wadsworth Publishing Co., Belmont, California, 1975.

DESALINATION



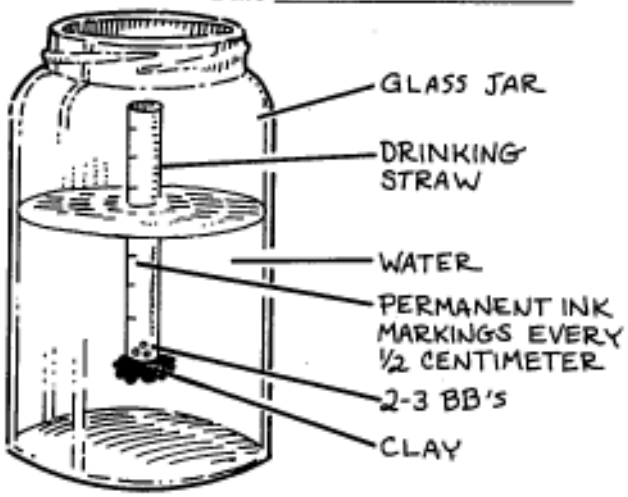
1. Spray paint one of the 2-liter bottles black before class.
2. In a clear pitcher mix 1/2 cup (125 mL) salt in 1 quart (1 L) of water.
3. Pour into the black 2-liter bottle.
4. Attach the clear tubing to both 2-liter bottles and secure with duct tape.
5. Set both bottles in a sunny window. Place the black bottle higher than the clear bottle.
6. Experiment with putting aluminum foil around the black bottle to heat it up more.

HYDROMETER

Name _____ Date _____

Materials (per team):

1 clear plastic drinking straw
small piece of clay
2 to 3 steel BB's
mayonnaise jar (or 2 liter bottle with the top cut off)
fresh water
pencil of permanent ink pen
metric ruler



1. Cut straw in half and fill one end with clay.
2. Mark off 1/2 centimeters along the straw with a permanent ink pen.
3. Fill the jar 3/4 full of tap water.
4. Put 2 or 3 BB's in the open end of the straw. Let them roll down to the clay.
5. Put the straw into the water, clay end down. It should float. Add BBs until your hydrometer floats very low in the water. Only 2 or three lines should be above the water.
6. Record the exact level at which your hydrometer floats. When testing, the higher your hydrometer floats, the more dense or salty the liquid is. Pour the tap water out of the jar.
7. Your teacher will provide you with three samples to test. They are labeled A, B, and C.
8. Gently put your hydrometer into each liquid sample (one at a time) and record the level at which it floats each time.

Observations and conclusions:

1. Including your fresh water sample, list the samples in order of least dense to most dense.

_____

_____

2. In a liquid less dense than water, how would your hydrometer float?

_____

3. In a liquid more dense, how would your hydrometer float?

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4. Compare a floating object in salt water and fresh water.

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