WATER FILTRATION

SUBJECTS:
Art, Chemistry, Language Arts

TIME:
2 class periods

MATERIALS:
two 2-liter plastic soda bottles
scissors
1/4 cup topsoil
water
plastic quart container with lid
paper coffee filter
builder's sand
crushed charcoal briquettes
clock
teacher sheet
student sheets

OBJECTIVES

The student will do the following:

1. Define potable and identify water that is potable.
2. Depict an illustration of the water treatment cycle.
3. Identify problems with treating dirty water.

BACKGROUND INFORMATION

Wetlands serve as highly effective surface water purification systems by reducing the effects of sedimentation in rivers, lakes, and estuaries. When turbulent, sediment-laden water encounters masses of wetland plants, it loses its energy and adds its sediments to the wetlands soil. These sediments may carry potentially harmful substances such as excess nutrients, which may lead to eutrophication, as well as pesticide residues and heavy metals with the potential to bioaccumulate.

The real "workhorses" in this natural water purification plant are the microbes. These tiny organisms are able to take many types of toxins and break them down into harmless substances. Those which cannot be broken down are likely to become sequestered within ever-increasing volumes of organic debris. These systems are so effective that they are often utilized by wastewater treatment plants.

How To Purify Water
Boiling is probably the best way to purify water. There is some debate about how long water needs to be boiled before it is safe to drink. Opinions vary from three minutes of a rolling boil to even just a few seconds. There are many water purification devices on the market; all use one or more of the following techniques to clean water:

Micropore filter: tiny holes that big germs can't pass through. This will stop larger microorganisms, such as amoeba and giardia, but bacteria and viruses will pass through.

Iodine: a filter, usually in the form of a membrane, containing a potent form of iodine that latches on to microorganisms as they pass through and kills them. Viruses are killed quickly; the larger germs may require several minutes to be effectively neutralized.

Charcoal: does not have much anti-bacterial effect, but it will remove bad odors and tastes, and some chemical pollutants. It is sometimes provided as an addition to the regular water purification device.

The flashlamp system is a new method still being developed. The high-intensity light generated by the flashlamp system has the ability to actually break DNA strands, and in doing so alter the chemical composition of a substance to render it both harmless and unable to reproduce. Moreover, the sheer intensity of the light produces a kill rate that can effectively decompose viral and microbe contaminants. Treating recirculated water with light is attractive because it does not contribute mineral salts or toxic residues that limit the potential for subsequent reuse of treated water.

Terms

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

microbe: a microorganism (microbiological organism).

potable: fit or suitable for human consumption, as in potable water.

ADVANCE PREPARATION

A. Prepare an overhead of the attached water treatment cycle.

B. Prepare a water filter using a plastic liter soda bottle with the bottom cut off, the label peeled off, and a one-hole stopper carrying a short length of glass tube inserted into the small end of the soda bottle. Put a little cotton wool in the bottom and then a layer of small clean pebbles. Wash some coarse sand well and place a layer above the pebbles. Next wash some fine sand and make a thicker layer in the filter. Grind up some wood charcoal and make it into a paste with water. Spread the charcoal paste evenly over the surface of the sand. Secure some very muddy water and pour in the top of the filter. Collect the filtrate in a clean glass placed below the filter. (See diagram.)

PROCEDURE

I. Setting the stage

A. Conduct the above experiment and ask for volunteers to drink the potable water.

B. Ask the class to brainstorm ideas of what potable water is. Ask them what word they might confuse with potable.

C. Give the class the correct definition of potable water for their notes. Ask the class to brainstorm ways their school gets potable water.

D. To introduce the water treatment cycle, read <u>The Borrowers A float</u> by Mary Norton.

E. Produce the overhead and compare it to the borrowers' journey and the conducted experiment

F. Have students illustrate cartoons about the borrowers' journey down the drain, thorough a pipe and into a river.

II. Activity

A. Explain to the students how they will recreate the water treatment system for their classroom.

B. Divide the class into cooperative groups.

C. Have each group make muddy water by mixing 1/4 cup of topsoil with water in a quart container. Put the lid on the container and shake.

1. Now make a water filter by cutting the top off a soda bottle about 4 inches below the spout (the teacher should help). Turn the top upside down and rest it in the remainder of the bottle.

2. Wet some sand and put a 1-inch layer in the coffee filter.

3. Put a 1-inch layer of crushed charcoal on top of the sand. Then cover with another 1-inch layer of wet sand.

4. Slowly pour about 1 cup of muddy water into your filter. Be sure to leave some muddy water so you can compare it to the filtered water.

5. Time how long it takes the water to begin filtering. Is the water that passed through the filter cleaner than the water in the other container?

D. Have the groups record their findings and present them on the attached chart.

III. Follow-Up

A. Have the students answer the following questions.

1. Compare the muddy water and the filtered water, explaining how sand can clean the water.

2. What parts of this experiment represent steps used by water treatment plants?

3. Why could or couldn't you use it to make a powdered drink?

IV. Extensions

A. Have groups draw new cartoons that depict the borrowers' journey through the class filter system.

B. Brainstorm problems that could arise in the class's filter system.

RESOURCES

Johnson Cynthia C. Waterways, Division of Public Information St. Johns River Water Management District, 1991.

Norton, Mary. The Borrowers Afloat, ISBN 0-15-2105340-4.

Water Purification Techniques: http://www.achilles.net/~petert/water.html

Polygon Industries Inc., author: Water Purification: http://www.polygon1.com/waterpurification.html

Water Purification Capabilities: http://hermes.ecn.purdue.edu:8001/http_dir/Gopher/agen/agen521/Lessons/Wetlands/purification.html

Directions: Draw a diagram of your filter, then record the data you collect.

Filter Set-Up:

Step 1: Cut the soda bottle off 10 cm below the spout. Turn the top upside down in the rest of the bottle. Put a coffee filter in the bottle.

Step 2: Wet some builder's sand and put a 2.5 cm layer in the coffee filter.

Step 3: Put a 2.5 cm layer of crushed charcoal on top of the sand, then cover with another 2.5 cm layer of wet builder's sand.

Step 4: Slowly pour 250 mL of muddy water into your filter. Save some muddy water to use as a comparison.

Step 5: Time how long it takes the water to begin filtering and record what the water looks like.

Time	What the Water Looked Like
Time 0	
30 seconds	
1 minute	
1 minute, 30 seconds	
2 minutes	
2 minutes, 30 seconds	
3 minutes	
3 minutes, 30 seconds	

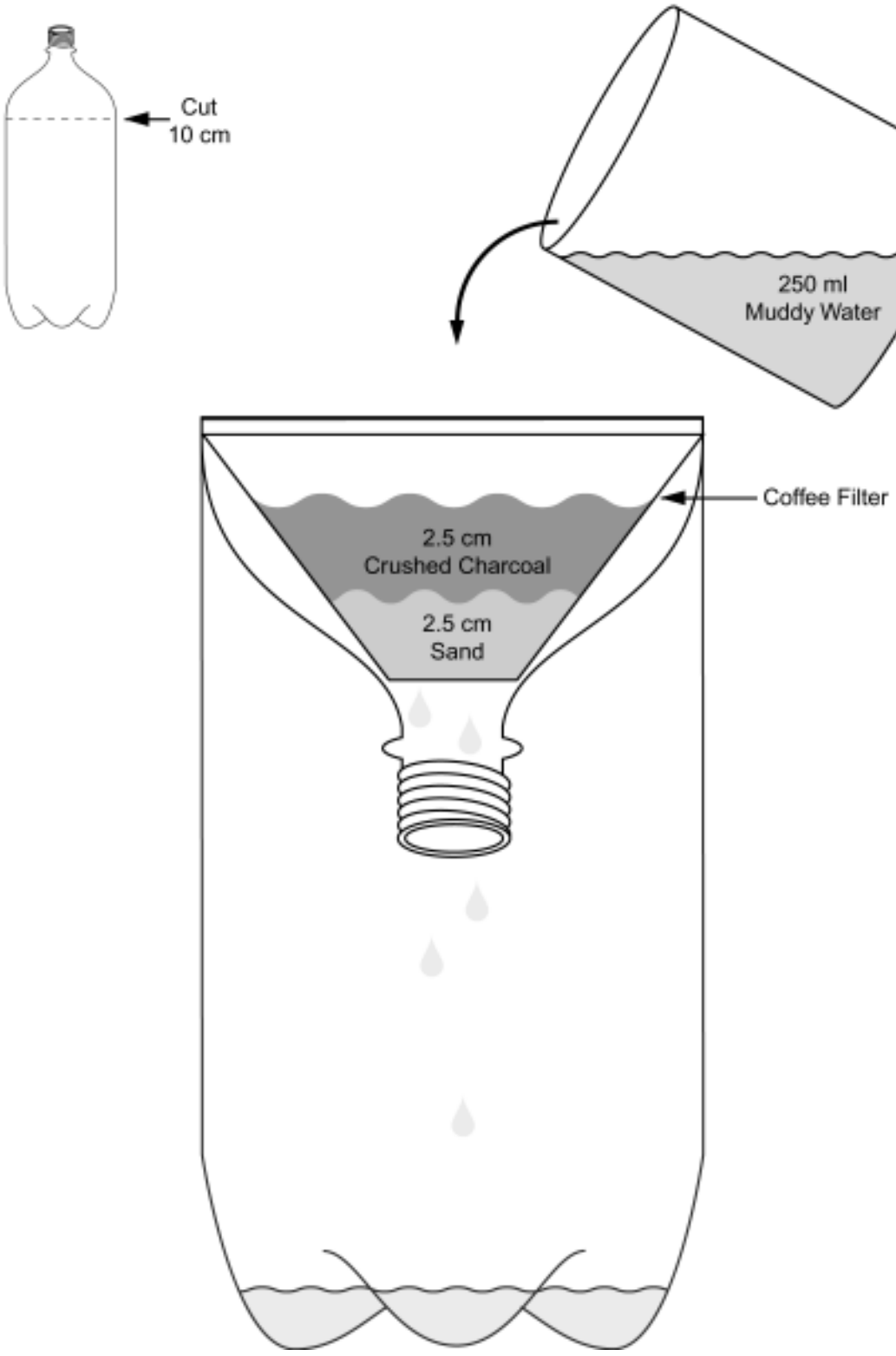
Please answer the following questions:

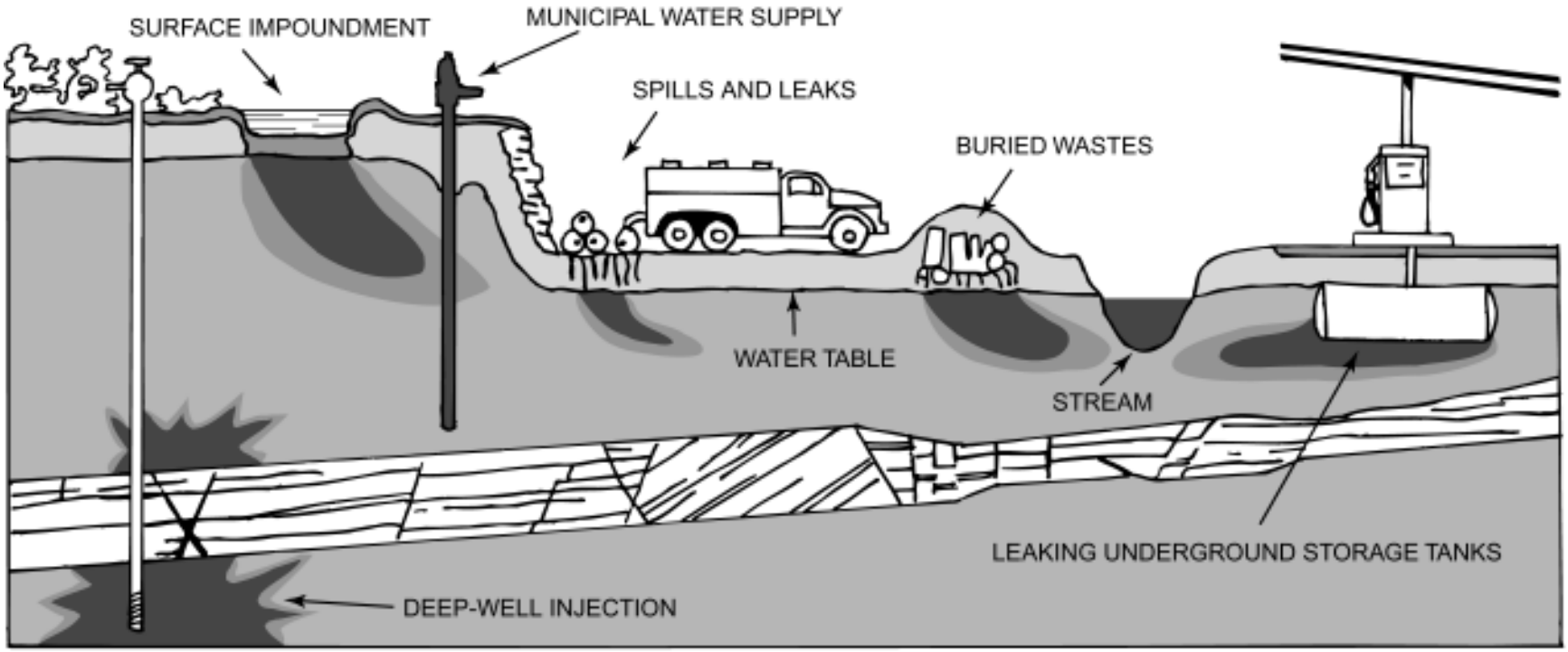
1. How did the filter clean the muddy water?

2. Is the water potable? Why or why not?

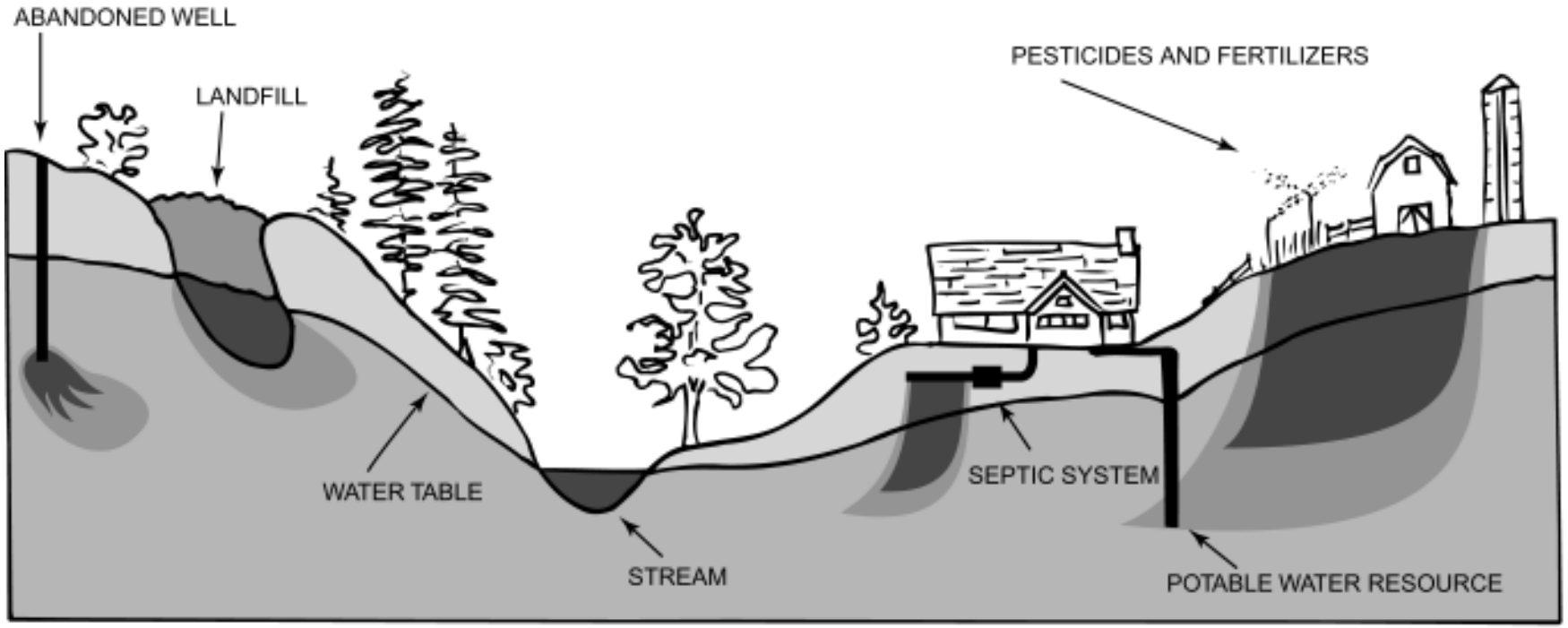
3. What could still be in the water?

4. What parts of your experiment represent steps used by water treatment plants?


Cut
10 cm
250 ml
Muddy Water
Coffee Filter
2.5 cm
Crushed Charcoal
2.5 cm
Sand



Industrial and Commercial Contamination Sources



Municipal and Rural Contamination Sources