3 Display the Water Filtration System chart where all the students can see it.

BACKGROUND INFORMATION

The same pollutants found in the air can eventually fall to the ground and pollute our water. However, the biggest sources of freshwater pollution are sewage, industrial and agricultural waste, and mining. Polluted ponds and lakes are often unable to support fish and other aquatic life. Polluted rivers carry their waste to the ocean, which is itself subject to oil spills and dumping.

Almost all water must be cleaned before it is fit to drink. ***Filtration***—either naturally through the ground or through a specially designed water purification system—is a commonly used method of cleaning water.

▼ **Activity Sheet 3**

Don't Muddy the Water

1. Record the location of the water source for Samples A, B, C, and D.
2. Use the scale below to assign a visible pollution level to each water sample.
3. Describe the appearance of each sample before and after filtering.
4. Describe the particles trapped in the cotton filters.

Particle Pollution Scale

Sample	Location of Water Source	Visible Pollution Level	Appearance		Description of Particles in Filter
			Before Filtering	After Filtering	
A	Answers will vary.				
B					
C					
D					

Visible Pollution Scale

Level	Appearance
Low	clear; looks clean
Medium	gray; cloudy; some particles
High	dark; muddy; many particles

5. What is the relationship between the location of the water source and the concentration of particles found in the water?

Ponds and other nonmoving water sources produced samples that contained the most particles. Water obtained from faucets was much clearer.

Guiding the Activity

Session I

1 Divide the class into teams of four. Give each student a collecting jar with a lid, a piece of masking tape, a marker, and a copy of **Activity Sheet 3.** Explain that each team will need to collect one water sample from four different sources (such as ponds, streams, puddles, rain, faucets, or drinking fountains).

2 When each team has decided where it will obtain its samples, have the members fill in the column on Activity Sheet 3 under the heading *Location of Water Source*.

Tell the students to use a piece of masking tape and the marker to label their collecting jars with their name and *Sample A, B, C,* or *D,* depending on which sample they have chosen to obtain. Have them write the location of the water source on the tape as well. Tell the students to bring their water samples to class for Session II.

Additional Information

Encourage students to seek out unusual water sources. Some students may be able to obtain samples from a factory or agricultural run-off area. Others may have access to a lake or stream. Still others may know of private wells.

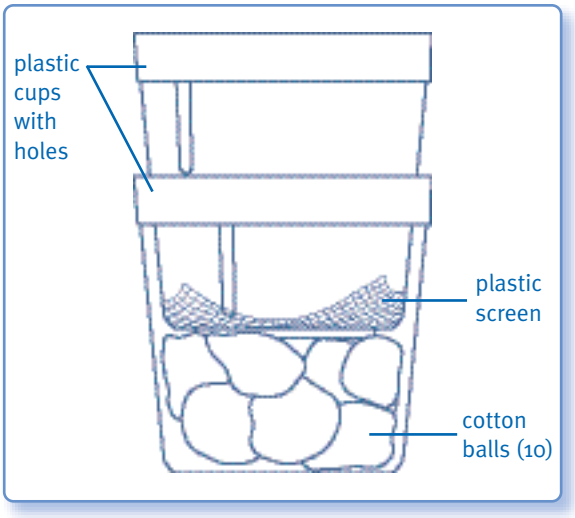
Guiding the Activity

Session II

3 Divide the class into the same teams of four. Tell each team to have its four jars of water samples handy. Then direct their attention to the chart of the water filtration system while you distribute the magnifiers, sandwich bags, pieces of tape, cotton balls, cups, beakers, screens, and paper towels to each team.

Next, write the word *filtration* on the board and explain that **filtration** refers to the process of removing impurities from a liquid by passing it through a porous substance (such as a filter). Tell the students that they are going to make a water filtration system like the one in the chart and use it to test the purity of their four water samples.

4 To build a water filtration system, have each team take the two plastic cups with holes in them and place ten cotton balls in one cup and a screen in the other. Tell them to place the cup with the screen inside the cup with the cotton balls (see Figure 5-1).



▲ ***Figure 5-1.*** *Place the cup with the screen inside the cup with the cotton balls.*

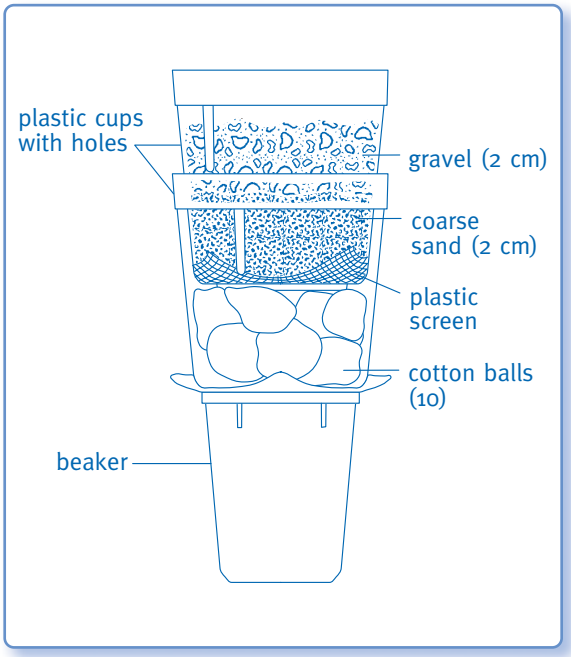
5 Have one member from each team bring the two cups, fitted together, up to the distribution station. Pour a layer of sand 2 cm (about $^3/_4$ in.) thick into the cup with the screen. Pour a layer of coarse gravel 2 cm (about $^3/_4$ in.) thick on top of the sand. Have the students return to their seats and set the two cups on top of one of the beakers (see Figure 5-2). The filtration system is now ready for water Sample A.

Additional Information

Make sure the sand and gravel have been rinsed thoroughly and are free of dust.

Guiding the Activity

Additional Information



▲ ***Figure 5-2.*** *The completed water filtration system.*

6 Direct each team to observe the appearance of the water in the jar they have labeled Sample A. Have the students use the Visible Pollution scale at the bottom of the activity sheet to help them describe the physical appearance of the sample. Have them enter this level on the activity sheet under the heading *Visible Pollution Level*. Additional descriptive details can be included under the column heading *Appearance: Before Filtering*.

7 Have the teams pour about 100 mL of Sample A into their other beaker.

Any remaining sample water should be saved for Activity 8.

Next, have them pour their measured sample through the filtration system. After the water has passed through the layers of sand, gravel, and cotton and collected in the beaker at the bottom, ask, **How does the appearance of the water before filtering compare with its appearance after filtering?**

Unless the sample water is quite clean to begin with, the water should be noticeably clearer after filtration.

Tell the students to add this information to the activity sheet under the heading *Appearance: After Filtering*.

Guiding the Activity

Additional Information

8 Have the students remove the cotton-ball filter from the filtration system and squeeze out the excess water. Tell them to store the used cotton balls in a plastic sandwich bag and to label the bag *Sample A*.

After students have had ample opportunity to examine the beaker of filtered water and compare it with the jar of unfiltered water, tell them to empty the beaker into a sink or other receptacle.

Safety Note: *Caution the students not to drink this water. Microorganisms that can cause disease may still be present in the water, even after it has been filtered.*

9 Before filtering the next sample, have the students rinse their filtration systems with a small amount of distilled water, dispose of this water, and then insert a new 10-cotton-ball filter. Repeat steps 6 through 8 with water Samples B, C, and D, rinsing the filtration system with distilled water and replacing the cotton filter between each sample.

10 After all four water samples have been filtered and the used cotton filters stored in sandwich bags, direct the students to remove the cotton balls from each bag and examine them using a magnifier. Have them describe the particles they see and record their observations on Activity Sheet 3 under the heading *Description of Particles in Filter.*

11 Ask, **Which water sample contained the most particles?**

Students should name the water sample that produced the dirtiest cotton filter and/or the dirtiest water, even after filtering.

Ask, **What do you think was the source of the particles found in each water sample?**

Soot and ash from factories, dirt from yards, plant waste and dust from farms are all possible responses.

Ask, **What is the relationship between the location of the water source and the concentration of particles found in the water sample?** Have the students write their answers on the activity sheet and then share them with the class.

Students may respond that water samples taken from sources outdoors, such as streams and puddles, seemed dirtier than water samples taken from faucets and drinking fountains.

Guiding the Activity

	Additional Information
Ask, **Is the water that contains the most particles also the most harmful to organisms in the environment?**	*Not necessarily. The particles in a water sample may not be harmful to all organisms in the environment. For example, particles of decaying plant matter may contaminate drinking water, but they serve as fertilizer for growing plants.*
Ask, **Is water that has had particles filtered out of it now free of pollution?**	*Not necessarily. Some particles of pollution are so small that they are not caught in the filtering process. Similarly, a water sample may be particle-free but still contain bacteria and other harmful microorganisms which pass right through a filter.*
Ask, **Is filtration a good method of removing pollutants from drinking water? Can you think of another method of purifying water?**	*By now, students should understand that filtration is an effective way to remove many of the particles and pollutants from drinking water, but it does not by itself ensure the safety of the water. If they have not already done so, suggest that chemicals like chlorine are usually added to kill germs and other microscopic organisms that can cause illness. Boiling the water also kills germs.*

Reinforcement

To illustrate how airborne pollutants can end up in water, ask students to hang a particle detector and place a bowl of water in a place they think has a lot of particles in the air. After two days, have them examine the particle detector and the water in the bowl. Ask them to compare the particles on the particle detector with the ones in the water and to describe the relationship between air pollution and water pollution.

Science Journals

Have students place their completed activity sheets in their science journals.

Cleanup

Save the unused portion of the students' water samples for use in Activity 8. Dispose of the sandwich bags, gravel, sand, and cotton balls. Wash the cups, beakers, and plastic screens and return them, along with the magnifiers, to the kit.

Science at Home

Many households have installed water filtration systems to improve the quality of their drinking water. Have students find out whether or not their homes use these filters and, if so, where they are located and how they work.

Connections

Science Challenge

Have students build models of a well as described in the second Science Extension below but using different materials instead of sand—soil, gravel, mixtures of soil and sand or soil and clay, and so forth. How does each material affect the movement of water into the well and the clarity of the water? Encourage students to devise a way to use their models to demonstrate that pollutants on Earth's surface eventually find their way into wells. Students could, for example, use food coloring, salad oil, vinegar, or perfume as "pollutants" in the water they pour into the container.

Science Extension

- Have each group fill a clear glass jar about two-thirds full of water, add a spoonful of soil, mix well, and then let the jar sit. Students will see that larger soil particles settle to the bottom of the jar but smaller particles remain suspended. Then have them add a teaspoonful of alum to the jar, mix well, and let the jar sit again. (*Note:* Alum is available in the spice section of a supermarket.) This time, the alum will cause the finer soil particles to clump together and settle out as well. Explain that these same processes, called *sedimentation* and *coagulation,* are used by treatment plants to purify water.

- Give students the following instructions for making a model of a well. Roll a piece of fine-mesh window screening into a cylinder 1–2 cm ($^1/_2$–$^3/_4$ in.) in diameter, and fasten it so it will not unroll. Put the cylinder in a tall glass jar and pour sand around it. Then pour water onto the sand. Water will flow from the sand (the aquifer) into the cylinder (the well). If you draw water out of the well with a medicine dropper, the water level in the aquifer drops. If you pour more water on the sand, the water level in the aquifer rises.

Science and Math

Explain that about 75 percent of Earth's surface is covered by water, but only a tiny percentage of that water is fresh water available for use. Ask students to find out the percentages of salt water, unavailable fresh water (water trapped in glaciers and ice caps or deep underground), and available fresh water (in rivers, lakes, soil, and air) on Earth. Have students make a pie chart showing these percentages.

Science and Social Studies

- Tell students that the Cuyahoga River in Ohio was so polluted with industrial wastes in the 1950s and 1960s that it actually caught fire several times. Encourage interested students to research the Cuyahoga's long history of pollution and the steps that were taken to clean up the river.

- Post a map of your town or region in the classroom, and have students mark it to show known and possible sources of water pollution. Students can obtain this information from the regional office of the U.S. Environmental Protection Agency, state environmental and health agencies, or a local Board of Health. Tell students to mark each type of water pollution in a different color—for example, red for industrial wastes, blue for sewage, and brown for agricultural pesticides.

Science, Technology, and Society

Ask students to research the different methods that water treatment plants use to purify water. Suggest that they also find out whether and how water is pretreated in their own community. If possible, arrange a class visit to a water treatment plant. Many such plants welcome student tour groups and will provide a guide to explain the purification process.