Safe Drinking Water Lesson: Water Filtration

BACKGROUND:

Water in lakes, rivers, and swamps often contains impurities that make it look and smell bad. The water may also contain bacteria and other microbiological organisms that can cause disease. Consequently, water from surface sources must be "cleaned" before it can be consumed by people. Water treatment plants typically clean water by taking it through the following processes: (1) **aeration;** (2) **coagulation;** (3) **sedimentation;** (4) **filtration;** and (5) **disinfection.** Demonstration projects for the first four processes are included below:

OBJECTIVE:

To demonstrate the procedures that municipal water plants use to purify water for drinking.

MATERIALS NEEDED:

5 Liters of "swamp water" (or add 2 cups of dirt or mud to 5 liters of water)
1 Two liter plastic soft drink bottle with its cap (or cork that fits tightly into the neck
2 Two liter plastic soft drink bottles - one bottle with the top removed and one bottle with the bottom removed.
1 One and one half Liter (or larger) beaker or another soft drink bottle bottom
20 gramsof alum (potassium aluminum sulfate - approximately 2 tablespoons; available in pharmacy or spice isle in grocery store)
Fine sand (about 800 ml in volume)
Coarse sand (about 800 ml in volume)
Small pebbles (about 400 ml in volume) (Hint: washed natural color aquarium rocks will work)
1 large (500 ml or larger) beaker or jar
1 coffee filter
1 rubber band
1 tablespoon
A clock with a second hand or a stopwatch

PROCEDURE:

1. Pour about 1.5 L of "Swamp Water" into a 2 L Bottle. Have students describe the appearance and smell of the water.

2. **Aeration** is the addition of air to water. It allows gases trapped in the water to escape and adds oxygen to the water. Place the cap on the bottle and shake the water vigorously for 30 seconds. Continue the aeration process by pouring the water into either one of the cut-off bottles, then pouring the water back and forth between the cut-off bottles 10 times. Ask students to describe any changes they observe. Pour the aerated water into a bottle with its top cut off.

3. **Coagulation** is the process by which dirt and other suspended solid particles are chemically "stuck together" into floc so that they can be removed from water. With the tablespoon, add 20 g of alum crystals to the swamp water. Slowly stir the mixture for 5 minutes.

4. **Sedimentation** is the process that occurs when gravity pulls the particles of floc (clumps of alum and sediment) to the bottom of the cylinder. Allow the water to stand undisturbed in the cylinder. Ask students to observe the water at 5 minute intervals for a total of 20 minutes and write their observations with respect to changes in the water's appearance.

5. Construct a filter from the bottle with its bottom cut off as follows:

a. Attach the coffee filter to the outside neck of the bottle with a rubber band.
Turn the bottle upside down and pour a layer of pebbles into the bottle - the filter will prevent the pebbles from falling out of the neck.

b. Pour the coarse sand on top of the pebbles.

c. Pour the fine sand on top of the coarse sand.

d. Clean the filter by slowly and carefully pouring through 5 L (or more) of clean tap water. Try not to disturb the top layer of sand as you pour the water.

6. **Filtration** through a sand and pebble filter removes most of the impurities remaining in water after coagulation and sedimentation have taken place. After a large amount of sediment have settled on the bottom of the bottle of swamp water, carefully - without disturbing the sediment - pour the top two-thirds of the swamp water through the filter. Collect the filtered water in the beaker. Pour the remaining (one-third bottle) of swamp water back into the collection container. Compare the treated and untreated water. Ask students whether treatment has changed the appearance and smell of the water.

NOTE: Advise students that the final step at the water treatment plant is to add disinfectants to the water to purify it and kill any organisms that may be harmful. Because the disinfectants are caustic and must be handled carefully, it is not presented in this experiment. The water that was just filtered is therefore unfit to drink and can cause adverse effects. It is not safe to drink!

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