

GET IT TO THE SPIGOT

GRADES 3-8

MATERIALS

- 1 gallon of tap water in a bottle with a cap
- 2 quarts of tap water
- 2 cups of dirt or mud
- 2 2-liter plastic soft drink bottles
- 3 large beakers or large clear measuring cups
- 2 tablespoons of alum (potassium aluminum sulfate, available in the spice aisle at grocery stores)
- 1 1/2 cups fine sand (white play sand or beach sand)
- 1 1/2 cups coarse sand (multi-purpose sand)
- 1 cup small washed pebbles (natural color aquarium rocks work best)
- 1 coffee filter
- 1 rubber band
- 1 tablespoon for the alum
- 1 large spoon for stirring
- A clock with a second hand or a stopwatch

BACKGROUND

Did you know? All of the water that is here on Earth right now is the same water that was here at the time of the dinosaurs. It's all the water the Earth will ever have! The same water is used and recycled over and over again.

Before water gets to your spigot, tap, faucet, or drinking fountain, it has been cleaned and purified through several different means. When water filters through the soil and travels through the water cycle it is purified, so it can be used by people, animals, plants, and other living organisms. Many communities today also have municipal water treatment plants that provide a comprehensive, multi-step treatment process to ensure that the tap water is safe, clean, and readily available to all. Learn about each of the different steps and how the overall water treatment process works in this highly visual exploration activity.

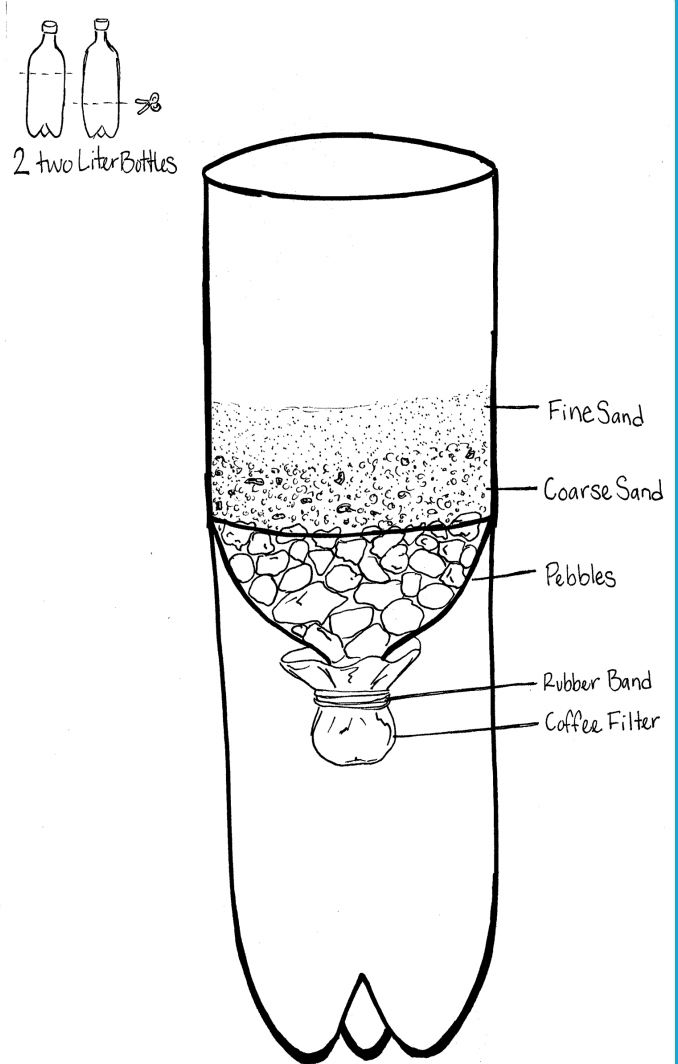
BPA in Bottled Water

Polycarbonate plastic—the kind of plastic used for most bottled water bottles and can liners—contains an industrial chemical called bisphenol A (BPA). Research from 2008 onward has shown that BPA can leach out of the plastic and into the contents of the plastic container, such as the water inside a bottle. Even small amounts of BPA can cause damage to the body, including alterations of the hormonal system, so numerous organizations have voiced serious concern over its use in containers of food and drink.

The United States, the European Union, Canada, South Africa, and China have all banned the use of BPA in baby bottles, and in 2010 the Canadian government officially declared BPA a toxic chemical. However, despite mounting concern, it remains common in other containers, including bottled water bottles.

TEACHER PREPARATION

- Pour the two cups of dirt or mud into the gallon bottle of clean water. Shake to mix the dirt and water together.
- Prepare the plastic soft drink bottles by cutting the bottom off one of them and the top off another.
- Construct a filter from the two plastic bottles as follows (see diagram on right):
- Attach the coffee filter to the outside neck of the bottle top with a rubber band.
- Turn the bottle top upside down, fitting it inside the bottle bottom.
- Pour a layer of pebbles into the bottle; the filter will prevent the pebbles from falling out of the neck.
- Pour the coarse sand on top of the pebbles.
- Pour the fine sand on top of the coarse sand.
- Clean the filter by slowly and carefully pouring through two quarts of clean tap water. Try not to disturb the top layer of sand as you pour the water.
- Clean the bottle bottom so it can be used for filtration in the activity.



DEFINITIONS

Pollution - The introduction of harmful material into an environment.

Aeration - The first step in the water treatment process, adding air to water. This allows gases trapped in the water to escape and adds oxygen to the water.

Coagulation - The process by which dirt and other suspended solid particles chemically “stick together” into flocs (clumps of alum and sediment) so they can easily be removed from water.

Sedimentation - The process that occurs when gravity pulls the flocs to the bottom of the cylinder or settling basin.

Filtration - The process of moving through a filter to remove most of the impurities remaining in water after coagulation and sedimentation have taken place.

Disinfection - the process of cleaning with disinfectant chemicals to kill harmful organisms.

INSTRUCTIONS

1. Prompt students to discuss the differences between the dirty water in muddy creeks and rivers, and the drinkable water that comes out of the tap. Discuss how dirty water gets polluted (erosion, washing personal products down drains, etc.). Explain that this activity will show them the journey that polluted water has to go on before it's safe to drink.

2. Show them your bottle of dirty water. Have students describe the appearance and smell of the water.

3. Begin the journey to the spigot! All of the following steps will be described in second-person for convenience, but consider using student volunteers for them to increase engagement.

4. Explain the **aeration** process (see Definitions on page 2; you may want to write this and the other defined words on the board when you explain them). Place the cap on the bottle and vigorously shake the bottle for 30 seconds. Continue the aeration process by pouring some of the water back and forth between the two beakers about 10 times. Once aerated, gases have escaped (bubbles should be gone). Pour your aerated water into the third beaker. Leave the untreated water (the amount you haven't poured back and forth) inside the gallon bottle and set it aside for now.

5. Explain the **coagulation** process. Add two tablespoons of alum to the aerated water in the beaker. Slowly stir the mixture for 5 minutes. You will see particles in the water clinging together to make larger clumps. This makes it harder for them to get through a filter at the plant.

6. Explain the **sedimentation** process. Allow the water to stand undisturbed in the beaker. Observe the water at 5 minute intervals for a total

of 20 minutes. Write down what you see; what is the appearance of the water now? (At a treatment plant, there are settling beds that collect flocs that float to the bottom, allowing the clear water to be drained from the top of the bed and continue through the process.)

7. Explain the **filtration** process. Reveal the filter you've made, showing how the pebbles and sand are layered so the water can run through. After a large amount of sediment has settled on the bottom of the bottle of dirty water, carefully—without disturbing the sediment—pour the top two-thirds of the dirty water through the filter, collecting it in the bottle bottom underneath.

8. Compare the treated water in the bottom of the filter to the completely untreated water left in the gallon bottle. Ask students whether the treatment has changed the appearance and smell of the water.

9. Explain that the final step at the treatment plant is to add disinfectants, such as chlorine, to the water to purify it and kill any organisms that may be harmful, making it safe to drink. (The water that was just filtered has not been disinfected, and is therefore still unfit to drink and can cause adverse effects. Do not drink it!)

OPTIONAL EXPANSION ACTIVITY

Take a field trip to the local municipal water treatment plant. See how the process works firsthand!

ADDITIONAL RESOURCES

For grades 6-8, consider pairing this activity with "Tap Into Persuasion," available on the Water Rocks! website, to explore the downsides of bottled water.

Adapted from http://water.epa.gov/learn/kids/drinkingwater/upload/2005_03_10_kids_activity_grades_4-8_water-filtration.pdf