

**Reading the River, Summer 2001**

**The Wonderful World of Water**

**Secondary: grades 9 –10**

**Biology and Integrated Science**

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**Title:** Dirty Water

**Objectives:** Students will be able to describe a variety of ways groundwater becomes polluted, how pollutants affect the water, and understand the importance of preventing water pollution.

**Program of Studies addressed:** *The Interdependence of Organisms: Students will explore how human activities alter ecosystems.*

**Core Content for assessment addressed:** *SC – H-3.5.5: Human beings live within the world’s ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities can threaten current and future global stability and, if not addressed, ecosystems can be irreversibly affected.*

**Materials:**     **2 one-gallon glass jars**  
                          **Kitchen strainer**  
                          **Paper coffee filter**  
                          **10 cups containing items highlighted below**

**Activity Procedure:**

Add water to both glass jars. This represents clear glacial melt-off before human impact. One jar serves as the control. Distribute the 10 cups of material to each student or pair of students. Give them a few minutes to think how their items might affect the water. Then, add one item at a time to one of the jars. As the item is added, discuss how the item might have entered the water system and affected the water.

1. **Twigs, leaves.** Natural pollutants that fell from trees decomposed and slowly released minerals into the soil. The minerals leached into the water.
2. **Ashes.** Residue from forest fires started from lightning and forest clearing activities by early settlers rapidly released minerals that percolated through the soil into the water.
3. **Cloth, paper.** Early traders brought these to this country. When discarded, they added chemicals to the soil.

4. **Apple core, onion skin.** Food wastes, from the time of early inhabitants until today, have always been concentrated in high population areas. These areas are also the places where there is the greatest demand for groundwater.
5. **Animal waste.** Throughout history, as populations grew, so did sewer systems. Early treatment facilities did little to “clean up” the waste. Today, many cities have overworked treatment plants, or storm sewers combined with sewage systems, allowing partially or untreated waste to enter waterways.
6. **Oil.** Some careless auto owners discard used motor oil on the ground, send it to the landfill, or dump it straight into storm sewers.
7. **Detergent.** Phosphates leach into the soil.
8. and 9: **agri-chemicals and soil.** Fertilizers, pesticides, and soil are continually washing off cropland and entering our water system.
10. **Baking soda and vinegar (mixed together).** Manufacturers and chemical handlers are often careless about disposal of toxic waste. Improperly buried materials filter through the soil.

After all the items have been added to the jar, ask about each jar, “Would you drink the water? Swim in it? Go boating in it? Water plants with it?”

Then say “let’s try to clean up the dirty water.” Pour the water through the kitchen strainer. Ask the same questions. Pour the water through the coffee filter. Ask the same questions. Ask students to think of other ways to clean the water.

Discussion:

- Which way is easier to have clean water – before things are added to it, or after? What are some ways in which we could lessen the amount of items from entering the water?
- Ask each student to think of one habit the he or she would be willing to change so that our water will be cleaner.
- How can the students help other people in the community to change one habit?
- Ask students, “how could we demonstrate the process of leaching and percolation?” Follow through with the ideas and let the students conduct the experiments.

### **Explanation:**

Thirty – five states are pumping groundwater faster than it is being replenished by nature. And in many areas, our groundwater is in serious jeopardy from pollutants. This activity helps students to graphically see the impact on groundwater.

**Assessment:**

Open response question : Since water is such a precious resource, list 3 ways that you can help to conserve water.

**References:** This activity came from “The KAEE Newsletter”, published by the Kentucky Association for Environmental Education. It is based on a previously-published article submitted by Carey Tichenor.

## Groundwater Model

**Level:** High School grades 8 – 12

**Title:** Groundwater Model

**Model for activity:** Envirosapes Groundwater Model

**Objective:** Students will demonstrate through building a model how aquifers are formed and groundwater becomes polluted.

**Program of Studies addressed:** *The Interdependence of Organisms: Students will explore how human activities alter ecosystems.*

**Core content addressed:** *SC – H- 3.5.1: Atoms (e.g. carbon, nitrogen) and molecules (e.g. water) cycle among the living and nonliving components of the biosphere.*

**Materials:** For each model:

- Groundwater model handout
- One 20 ounce clear plastic tumbler
- 12 inches of clear plastic tubing
- a small piece of nylon fabric to cover the end of the tubing
- masking tape
- small pebbles
- clean sand
- filter paper (e.g. a section of a coffee filter)
- pump-type sprayer (e.g. from window cleaner)
- a disposable syringe
- red food coloring
- a clear glass container

**Procedure:**

Older students can be divided into small groups to build the model, or can each build the model individually if there are enough materials. Have them use the Groundwater Model handout for reference.

1. Define groundwater and aquifers. Discuss with students the importance of ground water in the United States and the Ohio River Valley.
2. Secure nylon fabric over one end of the plastic tubing with masking tape or a rubber band.

3. Tape the tubing to the inside of the tumbler so that the nylon-covered end of the tubing *almost* touches the bottom of the tumbler.
4. Fill about one-third of the tumbler with pebbles.
5. Cut the filter paper into a circle with a diameter slightly larger than the diameter of the inside of the tumbler. Place the filter paper on top of the pebbles and tape it securely to the sides of the tumbler.
6. Fill the rest of the tumbler with sand.

Note: a shallow layer of potting soil can be added to the top of the sand to represent the Earth's crust.

7. With the sprayer, apply water to the sand until it is saturated. The water will filter down into the pebbles.
8. Put the end of the syringe into the tubing and make sure the connection is tight.
9. Pull back the plunger of the syringe to create a vacuum. Water will be drawn from the pebbles/sand into the tubing and ultimately into the syringe. Discuss with students that this represents how groundwater is pumped from aquifers.
10. Add a few drops of red food coloring to the sand. Explain that the red food coloring represents a pollutant. Discuss what kinds of substances can pollute the ground water.
11. Apply more water to the sand.
12. Continue "pumping" water from the tumbler with the syringe. When the syringe fills with water, remove it from the tubing and pour water into the clear glass container. Refasten the syringe to the tubing and continue "pumping" water. Ultimately, the water in the clear glass container will have a reddish hue. Discuss how the "pollutant" applied at the surface level has "contaminated" the "groundwater" in the experiment.

### **Explanation of Groundwater Contamination:**

*Groundwater* is water that exists in spaces in rock, gravel, and soil below the surface of the ground. Groundwater accumulates in formations called *aquifers* when rainfall and surface water percolate through the ground. There are two major environmental problems that can affect groundwater. The first is overuse of groundwater supplies. In general, water filters down into aquifers at very slow rates. This percolation of water into the aquifer is called *recharge*. When water is pumped from the aquifer at faster rates than it is recharged, the amount of water in the aquifer is reduced. This means that less water will be available for future use. In addition, the water takes up space in the aquifer. When the water is removed, void spaces open up and rock or sediments around these void spaces sometimes collapse. With the loss of void spaces, the aquifer's ability to hold water is reduced, and future recharge of the aquifer is more difficult. In addition, the collapse of void spaces can cause the ground to sink, a process known as subsidence. Roads, buildings, and natural features can be damaged when subsidence occurs.

The second major environmental problem is contamination. Groundwater is generally contaminated when chemicals and other pollutants filter down with water into the aquifer. The sources of these contaminants include runoff from agricultural and residential areas containing pesticides, herbicides, and fertilizers; runoff from roads containing oil, gasoline and other chemicals; releases of contaminants from landfills and other storage facilities; septic tank discharge; and sewer leakage. In some cases, contaminants are released directly into the aquifer from leakage or discharge from underground wells that are used to dispose of wastes. Once groundwater is polluted, it is very difficult and costly to treat.

**Assessment:**

Open response question: Discuss how groundwater contamination occurs in real-life situations and how it can be prevented.

**References:**

“Always a River” – Supplemental Environmental Education Curriculum on the Ohio River and Water Grades K – 12. Published by the U.S. Environmental Protection Agency 1991