Water Quality...Potential Sources of Pollution

GRADE SCHOOL EDITION

What is water quality? To most students, water quality may suggest only "clean" water for drinking, swimming, and fishing. But to the farmer or manufacturer, water quality may have an entirely different meaning. One of the most important issues concerning the quality of water is how that water will be used. Water that is perfectly fine for irrigation might not be suitable for drinking or swimming.

The quality of water can change as it flows over the land surface as rivers, streams, lakes, or ponds (surface water), or under the land surface (ground water). Because surface and ground waters are interconnected in some areas, changes in the quality of surface water can affect the quality of the area's ground water, and vice versa. These changes in water quality may be due to natural factors or human activities.

As rock minerals come in contact with water, some dissolve and become part of the surface- or ground-water system. Other natural materials, such as soil or organic matter, become suspended in the water and move from one place to another. The effects of human activities on water may result from land disturbances, which increase the amount of rock minerals, soils, or organic matter available to be transported by and dissolved in water, or from the addition of human-made pollutants. When water is degraded to a point that affects its use for a particular purpose, it has become polluted.

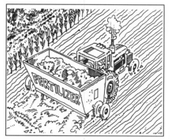
Water pollution originates from two very different sources: point sources and nonpoint sources. This poster depicts human activities associated with point sources (labeled in yellow) and nonpoint sources (labeled in red). Also displayed is the movement of pollutants from their sources to surface and ground waters. The stream flowing from the mountains on the left-hand side of the poster represents clean water not affected by human activities. The river on the left-hand side of the poster receives pollutants from point sources (wastewater-treatment plant, storm drain, and factory). The quantities of pollutants entering this river are reduced as a result of pollution-control measures. The river on the right-hand side of the poster receives pollutants from many nonpoint sources (suburban lawn, parking lot, construction site, landfill, logging area, septic tank, and agricultural field). This river receives large amounts of pollution because there are no pollution controls. The bottom part of the poster displays the movement of water between streams and the underlying aquifer.

The poster is folded into 8.5" x 11" panels; the front and back sides can easily be photocopied.

Point-Source Pollution

Pollution contributed to water from a discrete source, such as a pipe, ditch, tunnel, or well, are referred to as point sources. Generally, pollution from point sources are controlled to some degree by treatment technology. Municipal wastewater-treatment plants are one of the most common examples of treatment of point sources. While a municipal wastewater-treatment plant might receive water from many sources, it discharges into a water body at a single point.

Nonpoint-Source Pollution



Nonpoint source means that the pollution comes from a broad area, such as a large field that has been covered with fertilizer or pesticides. Excessive application of fertilizer or pesticides on agricultural lands or on lawns and gardens can create nonpoint sources. People who use fertilizers and pesticides must read labels to ensure that they are applying the materials properly.

A land-surface disturbance caused by humans, such as construction or logging, can create nonpoint sources of pollution. Pollution can occur when an increase in erosion caused by land disturbances produces large quantities of sediment, which is washed into rivers, streams, and lakes. Contamination can be reduced by preventing sediment from reaching waters through the implementation of erosion-control structures and the by planting and maintenance of soil-holding vegetation.

Disposal of garbage and trash at community landfills has the potential for polluting surface and ground water. Recycling of waste products such as oil, grease, plastics, paper, and aluminum reduces the potential for pollution from landfills. Many automobile products, such as gasoline and brake fluid, and household chemicals like cleaning solutions and turpentine, should not be placed in landfills but taken to special collection areas.

Oil and grease from automobiles, sand, gravel, salt, and other potential pollutants accumulate on parking lots and streets. Because very little water infiltrates into asphalt and concrete, the nonpoint-source pollutants that accumulate on them can be washed into surface waters during large storms. Prevention of this type of nonpoint pollution requires collection and treatment prior to discharge into surface waters.

Hazardous Materials

Hazardous wastes produced as byproducts of manufacturing can affect water resources. Proper handling, storage, and disposal of hazardous materials is critical to the prevention of their entry into surface and ground water. This requires moving these materials to a safe storage location. What can individuals do to stop hazardous-waste pollution? One method is to stop dumping oil, cleaning liquids, or unknown substances on the ground or down the drain.

ACTIVITY

Erosion

Introduction

Sediment results from the erosion of land surfaces and streambanks. One of the most effective means of controlling erosion is to protect the land surfaces and streambanks with vegetation and vegetative litter (leaves, twigs, and stems that fall from plants). Vegetation helps prevent erosion by holding soil in place. The vegetation canopy and resulting litter protect soil from the impact of rain drops, which can increase erosion. The following activity demonstrates the effectiveness of vegetative litter in preventing soil erosion.

Objectives -- Student will observe:

1. The effect of rainfall on soil erosion.
2. The effect of vegetative litter on the reduction of soil erosion.

Materials -- Each group will need:

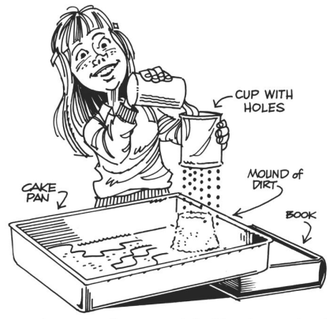
1. 480 mL of soil (in two 240-mL cups);
2. One cake pan or similar container at least 30 cm x 30 cm;
3. Four 240-mL paper cups;
4. Water; and
5. A large handful of vegetative litter (leaves, twigs, grass, and stems, etc.).

Teacher Preparation

1. This activity is designed for students to work in groups of three. If sufficient materials are not available, it can be done as a demonstration.
2. Using an ice pick or awl, punch 8-10 small holes in the bottom of one of the paper cups.
3. Take the students on a walk to a nearby park, woods, or field to collect soil and vegetative litter. Caution against collecting inorganic "litter" and animal waste. Also, warn students about coming in contact with poison ivy and other harmful plants.

Procedure

1. Divide the class into groups of three students. Provide each group with one cake pan, one 240-mL cup with holes punched in the bottom, two 240-mL cups filled with soil, one 240-mL cup filled 2/3 full of water, and a large handful of vegetative litter.
2. Have the students place one side of the cake pan on a thin book or tablet of paper to create a slight slope.
3. Have the students make a small mound with the 240 mL of soil at the upslope side of the cake pan. Explain to students that the mound represents a hill.
4. Instruct a student to hold the 240-mL cup with holes over the soil mound. Then add water to this cup. Explain to the students that they are simulating rain. Have the students observe the amount of soil in the "lake" at the bottom of the pan.



5. Introduce these words: **erosion** - the movement of soil from the mound, and **sediment** - the soil deposited in the lake at the bottom of the pan.
6. Remove the soil and water from the pan. Refill one paper cup 2/3 full of water. Repeat steps 2 and 3, using the second 240-mL cup of soil. Place the vegetative litter on top of the soil mound. Have it "rain" on the litter-covered mound as described in step 4. Have the students observe the amount of soil in the "lake" at the bottom of the pan.
7. Discuss with the students the differences between the amount of soil in the "lake" at the bottom of the pan following the two different erosion experiments.

Interpretive Questions

1. Which one of the mounds produced the greatest amount of sediment?

Answer: The mound that was not covered with vegetative litter.

2. What effect did the vegetative litter have on erosion?

Answer: It reduced the erosion by protecting the soil from direct impact of the "rain."

ACTIVITY

Surface-Water and Ground-Water Pollution

Introduction

Surface waters (rivers, streams, lakes, ponds) and ground waters are interconnected in some areas. That is, water can move from surface-water bodies to ground-water bodies and vice versa. If surface waters become polluted, this pollution can also affect the area's ground-water system. Likewise, polluted ground water can move into lakes, streams, or rivers. The following activity demonstrates the movement of pollutants from surface water to ground water as well as the difficulty in cleaning up the pollution.

Objectives -- Students will:

1. Observe the connection between surface and ground water; and
2. Experience the difficulty of cleaning up polluted water.

Materials -- Each group will need:

1. One 266-mL clear plastic cup;
2. Sufficient clean pea-sized gravel to fill the 266-mL clear plastic cup 3/4 full;
3. Three 240-mL paper cups;
4. One pump dispenser from soft-soap or hand-lotion containers;
5. 3.8 L of water; and
6. One bottle of food coloring.

Teacher Preparation

1. This activity is designed for students to work in groups of three.
2. Display a copy of the poster titled "Water Quality: Potential Sources of Pollution" on the classroom wall several days prior to conducting this activity.
3. Fill a clear plastic cup 3/4 full of clean pea-sized gravel for each group.
4. Using an ice pick or awl, punch 8-10 small holes in the bottom of one of the paper cups for each group. When filled with water, this cup will be used to simulate rain.
5. Fill one paper cup (without holes) 3/4 full of water for each group.

Procedure

1. Divide the class into groups of three. Provide each group with one clear plastic cup 3/4 full of pea-sized gravel, one paper cup with holes in the bottom, one paper cup with no holes punched in the bottom, one paper cup 3/4 full of water, and one pump dispenser.
2. Instruct the students to hold the 240-mL cup with holes in the bottom over the cup containing the pea-sized gravel. Then add the water contained in the other 240-mL cup. Ask the students what they think the water simulates (rain).
3. Explain to the students that rain enters the gravel and becomes ground water. This process is called infiltration.
4. Instruct the students to dig a hole in the center of the gravel. Ask them what the hole simulates. (Answer: A lake or pond.) Have students observe the connection between the level of water in the lake and how it corresponds to the level of water in the gravel.
5. Add two drops of food coloring (to simulate pollution) to each model lake. Have the students place the pump dispenser in the gravel beside the lake and pump water into the paper cup with no holes. Observe the color of the water in the cup.
6. Have the students add small amounts of clean water to their models while pumping. Continue to add clean water and pump out polluted water until it becomes clear.

Interpretive Questions

1. Where does the pollution pumped from the ground water come from?

Answer: The lake.

2. How can pollution from a lake get into the ground water?

Answer: The water in the lake and the ground water are connected.

3. Was it easy to clean up all the pollution in the water?

Answer: No. It took a lot of water and pumping to remove the pollution.

ORDERING INFORMATION

Single copies of the first four posters in the series (see Poster Series panel) and a limited supply of the "Water Quality" poster (color for grades 3-5 and 6-8 or black and white) can be obtained at no cost from the U.S. Geological Survey by writing to the following address:

U.S. Geological Survey
Box 25286
Denver Federal Center
Denver, CO 80225
Telephone: (303) 236-7477

In your letter, please identify the poster title and grade level desired.

Also, the poster entitled "Water: The Resource That Gets Used & Used & Used for Everything!" has been translated into Spanish. A limited supply of color or black-and-white copies can be obtained at no cost from the U.S. Geological Survey at the above address.

Poster Series

This poster is the fifth in a series of water-resources education posters developed through the Water Resources Education Initiative. The Water Resources Education Initiative is a cooperative effort between public and private education interests. Partners in the program include the U.S. Geological Survey and the U.S. Fish and Wildlife Service of the U.S. Department of the Interior, the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, the Nebraska Groundwater Foundation, and the National Science Teachers Association.

The other completed posters in the series are entitled "Water: The Resource That Gets Used & Used & Used for Everything!", "How Do We Treat Our Wastewater?", "Wetlands: Water, Wildlife, Plants & People!", and "Ground Water: The Hidden Resource!" The posters in the series are designed to be joined to create a wall mural. A schematic of the wall mural including the topics for the completed and planned posters is displayed on this panel. The light-shaded spaces indicate the completed posters. The dark-shaded space is this poster.

BIODIVERSITY	WATERSHEDS	ACID RAIN or HAZARDOUS MATERIAL
WETLANDS	WATER USE	WASTEWATER TREATMENT
OCEANS or NAVIGATION	GROUND WATER	WATER QUALITY

Water-resources topics of all completed posters are drawn in a cartoon format by the same cartoonist. Posters are available in color or black and white. The reverse sides of the color posters contain educational activities: one version for children in grades 3-5 and the other with activities for children in grades 6-8. The black-and-white posters are intended for coloring by children in grades K-5.

DEFINITIONS

Aquifer - An underground body of porous sand, gravel, or fractured rock filled with water and capable of supplying useful quantities of water to a well or spring.

Erosion - Process whereby materials of the Earth's crust are loosened, dissolved, or worn away and moved, usually by water or wind.

Ground Water - Water in the saturated zone beneath the Earth's surface.

Nonpoint Source of Pollution - Pollution from a broad area such as areas of fertilizer and pesticide application, rather than from point sources.

Point Source of Pollution - Pollution originating from a discrete source, such as the outflow from a pipe, ditch, tunnel, or well.

Sediment - Particles derived from rock or organic materials that have been transported by water or wind.

Surface Water - Water that is on the Earth's surface, such as rivers, streams, lakes, and reservoirs.

Unconfined Aquifer - An aquifer whose upper water surface (water table) is at atmospheric pressure and is free to rise and fall.

Water Pollution - Presence of any substance in water or addition of any substance to water that restricts the use of water.

Water Table - The top of the water surface in the saturated area of an aquifer.

ACKNOWLEDGMENTS

The following individuals contributed to the development of this poster:

Project Chief, Principal Author, and Layout: Stephen Vandas, U.S. Geological Survey, Denver, Colorado

Artwork: Frank Farrar, Frank Farrar Graphics, Denver, Colorado, under contract to the National Science Teachers Association

U.S. DEPARTMENT OF THE INTERIOR

As the Nation's principal conservation agency, the U.S. Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This responsibility includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also has a major responsibility for Native American reservation communities and for people who live in island territories under United States administration.

GRADE SCHOOL