Leach Out and Touch Someone

SUGGESTED GRADE LEVEL: 4
SUBJECTS: Science, Social Science
SKILLS: observation, inference, prediction, model formation

CORRELATION TO NEXT GENERATION SCIENCE STANDARDS: 4-ESS2-1

Objectives

Students will demonstrate how surface water and ground water may become contaminated from point and nonpoint pollution sources.

Method

Students construct models of groundwater pollution sources.

Background

What could a farm in the Midwest have in common with a remote wilderness area like Isle Royale National Park in Lake Superior? What could a landfill several miles away from your home have to do with your drinking water? Because of the interconnections between the land, air and water in the hydrologic cycle, they could be contaminated by the same chemicals.

There are several ways that surface water and ground water can be contaminated. For example, when hazardous chemicals are stored in the ground in tanks or barrels, the containers may corrode and allow the waste to leach into local surface water and groundwater sources. Since this leaching occurs from a single, relatively easily identified source, it is called a "point pollution" source. Another example would be a pipe traced back to an identified source such as a water treatment plant.

Other pollution sources are not as easily traced. Fertilizers, pesticides and soil may be washed into waterways by rainfall and snow melt. Oils, metals and other chemicals may be washed from city streets, parking lots and driveways. These "nonpoint pollution" sources may affect many square miles of surface water or land and eventually could be absorbed into the ground water. Current scientific studies show that farm chemicals routinely applied to crops have been found in such remote areas as Isle Royale. DDT, now banned in the United States, has been found all over the world, including in the Arctic Circle.

Literature Cited

Illinois Department of Natural Resources. 1992. *Groundwater: Illinois' buried treasure education activity guide*. Illinois Department of Natural Resources, Springfield, Illinois. 161 pp.

Materials

per group: one clear plastic container about the size of a shoebox; washed, fine, white sand; tube from an eyedropper with the rubber bulb removed; an eyedropper with a rubber bulb; food coloring and unsweetened powdered drink mix (red of one and blue of the other work well); a spray bottle; water; one copy of the "Leach Out and Touch Someone" student activity page for each student; a beaker or cup to pour water from; collecting buckets; pencils

Procedure

NOTE: This activity may be done as a demonstration. If done in demonstration format, you may wish to start it at the beginning of class and look at it periodically until a significant amount of movement and leaching has taken place. If you wish students to conduct the experiment in groups, be warned that it can be messy.

Per group

1. Distribute materials and copies of "Leach Out and Touch Someone" student activity page.
2. Fill container one-half full of sand, dampen so that it holds its form and try to create some topographic features, such as hills, valleys, rivers and lakes. Add water carefully to minimize erosion and observe what happens as more water is added.
3. Create a hill of sand and a low area of water that represents a lake, pond or river. Insert the dropper tube on the hill, well above the subsurface water level. Place it against the side of the container so that the dropper tip beneath the sand's surface can be seen. This tube represents a point source of pollution that can be traced to a water treatment plant or an industry.

4. Add a dropper of undiluted food coloring into the tube.
5. Produce a gentle spray of water above the point source to represent rain soaking into the ground. Watch closely at the bottom opening of the dropper tube, beneath the sand's surface. (Water generally flows very slowly through soil and rock beneath the earth's surface.) What happens to the surface water?

   NOTE: This apparatus may be left up overnight and observed again. Initially the leaching should occur rapidly but may take as long as 24 hours for the "pollution" to reach the surface water.
6. To demonstrate nonpoint sources of pollution, sprinkle unsweetened powdered drink mix on the surface of the sand to represent fertilizers, pesticides and oils. Use a different color than you used in step 4. Spray the water (rain) over the land surface in the model. What happens? Spray more clean water and observe. Eventually the nonpoint source also contaminates the ground water and surface water. How can you tell if the two types of pollution have mixed? (If red and blue colors were used, the polluted water should appear purple.)
7. The final step is to clean the coloring out of the sand. Rinse it out in the sink or collecting bucket by adding water, stirring the sand, allowing it to settle and pouring off the excess water. Be careful not to dump sand down the drain. Water in collecting buckets may be dumped outdoors or down the drain, if the sand is completely excluded. Is the sand easy to clean? How many rinses does it take until the water is clear?
8. Discuss with students if they think the "soil" in this model is easier or harder to clean than real soil and rock at a landfill or other possible point source of pollution. Is there any truly practical way to clean ground water once it has become contaminated? How does your model actually resemble real life situations? How is it different? What could you do to make it more realistic?

Extensions

1. Use topographic maps to identify uses of land around the area where the students live. Which of these uses may be possible sources of ground water or surface water pollution? What precautions are taken by your community to reduce and prevent water pollution? What could be done to reduce current pollution sources on an individual basis? What can a community do to prevent larger point and nonpoint sources of water pollution?
2. Challenge students to develop a clay liner that will block the leachate as described in this activity. Is this a practical solution to the problem? Where might clay be useful?
3. Have students graph the spread of pollutants over time. A wax pencil could be used to trace the spread on the side of the container in lieu of the graph.

Evaluations

1. Students should complete and turn in the "Leach Out and Touch Someone" student activity page.
2. Have students work in groups to create songs, posters, commercials, videos, podcasts or other creative demonstrations to illustrate the concepts of point and nonpoint water pollution, its problems and possible solutions. Have each group present the work to the class.

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Student Name _____

Team Members _____

SETTING UP

1. Collect all materials needed: a clear container; sand; an eyedropper without a rubber bulb; an eyedropper with a rubber bulb; food coloring; unsweetened powdered drink mix; a spray bottle; water; a beaker or cup.

2. Fill container one-half full with sand, dampen it and create a hill and a low spot.

PROCEDURE

1. Slowly (so as not to wash the sand away) add enough water so there is some in the low spot you created and observe what happens. What is the relationship between ground water and surface water?

2. Insert the eyedropper without a rubber bulb in the hill next to the side of the container. Add a dropper of food coloring into the tube. What type of pollution does this dropper of food coloring represent?

3. Spray water over the tube. What does this action represent? Observe the bottom of the tube under the sand and describe what happens. What does this demonstration tell you about groundwater movement? Do you think it flows rapidly beneath the earth?

Describe what happens to the surface water.

4. Sprinkle some unsweetened powdered drink mix over the sand. Spray water over the land surface in the model. What type of pollution is represented?

Spray more clean water and describe what happens.

How can you tell if the two types of pollution have mixed?

5. Try to rinse the coloring out of the sand. Using the designated area, add water, stir the sand and allow it to settle, pouring off the excess water. Is the sand easy to clean? How many rinses does it take until the water is clear?

RESULTS

How does pollution affect groundwater?