AQUIFERS AND NON-POINT SOURCE POLLUTION

K-STATE RESEARCH AND EXTENSION- SEDGWICK COUNTY
7001 W. 21st St. North
Wichita, KS 67205-1759
(316) 660-0100
FAX (316) 722-1432
Drescher@ksu.edu
http://www.sedgwickcountyextension.org

Cooperative Extension Service Sedgwick County
Extension Education Center
7001 W. 21st St. North
Wichita, KS 67205-1759
316-660-0100

FAX 316-722-1432
HOME PAGE
http://www.ksu.edu/sedgwick

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Suggested Grade: 3

If you dig deep enough in most areas of the world you will find water. It seeps into the ground through *infiltration* and *percolation* until it reaches a layer of rock that it can't get through. Water under the ground is called ground water. Ground water that settles in an underground reservoir of loose gravel and sand is called an aquifer (literally "water carrier"). Groundwater is the only source of drinking water for one half of the residents of the United States. It also supplies 35% of the municipal fresh water supplies, 40% of all irrigation water, and 26% of water used by industry.

Many communities obtain their drinking water from aquifers. Water supplier or utility companies often drill wells through soil and rock into aquifers to provide the public with drinking water, although sometimes the water from an aquifer emerges on the surface as a natural spring. The point at which a drill would reach an aquifer is called the water table. Aquifers with a high water table are near the earth's surface. Aquifers with a low water table are far below the earth's surface.

Most U.S. aquifers are within 2,500 feet of the Earth's surface; within easy reach of modern drilling equipment. In many regions water is pumped out of aquifers faster than it can be replenished. This not only uses up our existing natural resources, it can also cause the ground to contract and sink. This is called *subsidence*, and is a problem that many water-thirsty cities are facing throughout the world.

A large natural aquifer, called the Equus Beds, is located in Sedgwick County. It provides many people in Wichita with at least part of their drinking water. It has a very high water table (is close to the surface of the ground) and is located under very porous sandy soil. Because of the ease with which pollution is able to make its way into the Equus Beds, many people are concerned about protecting the environment so that the local community can continue to have safe and plentiful drinking water.

Even though soil, sand and rocks naturally purify water, sometimes the water carries pollutants that cannot easily be removed through natural filtration. Groundwater can become contaminated by improper use or disposal of harmful chemicals such as lawn care products and household cleaners. These chemicals can percolate down through the soil and rock into an aquifer and eventually into drinking water wells where they pose a serious threat to human health.

Where does our drinking water come from?

How can pollution in the environment threaten the safety of our drinking water?

OBJECTIVES

- ► Demonstrate how water is stored in an aquifer
- ► Demonstrate how pollution can enter the ground water from non point sources and end up in a drinking water well

MATERIALS

Each activity group will receive:

- ➔ 1 plastic container at least 6" to 8" deep, preferably with clear sides
- ➔ 2 to 3 cups sand
- ➔ 3 to 4 cups small stones
- ➔ 1 piece small wire mesh, about 6" X 8"
- ➔ Clear tape
- ➔ Spray bottle
- ➔ Red food coloring
- ➔ Eye dropper
- ➔ Water

PREPARATION ACTIVITIES

→ Ask students to complete the two water mazes on pages 9 & 10. These mazes are representations of different types of soils; one with large particles and air spaces (pores), and one with small particles and air spaces. After students have completed the mazes, lead a class discussion using the following questions as a guide:

Which maze was easier to get through?
(The large maze should be easier for most students to navigate)
Why do you think it was easier?
(Size of spaces should be mentioned–larger spaces are easier)

These mazes are a lot like soil–some soils have large spaces between the particles and some have small spaces. Which type of soil do you think would be easiest for water to move through?
(Large spaces)

Where does the water in the soil come from?
(Rain)

Where does the water go after it rains?

(It seeps through the soil into an aquifer)

What is an aquifer?

(An aquifer is water that has seeped through the soil and settles in loose gravel and sand underground)

→ Water moves through the soil by the processes of *infiltration* and *percolation.*

Infiltration is the process of water movement into the spaces (pores) between soil particles

Percolation is the process of water movement through the soil. Water that is percolating through soil often dissolves soil minerals, nutrients and/or pollution on its journey to the water table.

The speed of water movement through the soil is affected by the size of the spaces *(pores)* between the particles. The size of the spaces is determined by the size of the soil particles; the larger the particle, the larger the space.

To illustrate how the size of the pores affects the speed of infiltration and percolation through a soil, complete the following demonstration.

1. Fill a clear cup 3/4 full of small gravel. Fill another cup 3/4 full of sand. The difference in size between these two types of particles is similar to the difference in size between sand and silt, but the process of percolation is much more easily visible with sand and gravel than sand and silt.

Ask the class to describe the difference in pore size. Which one has larger spaces, or pores, between the particles? *(Gravel)* Which glass do they predict will allow water to move most quickly?

2. Pour ½ cup colored water into each glass as the students observe. In which glass did all the water reach the bottom first?

3. The water in this demonstration had food coloring added to it. What would happen if the water in our soil had pollution added to it?

→ Pollution of our surface and ground water can happen in two very different ways.

Point sources are easy to identify. The pollution from point sources can be seen to come from a factory discharge pipe, ditch or waterway.

Non-point sources are more difficult to find because they come from unspecified sources spread over a large area. Some common sources of non-point source pollution are agricultural pesticides and fertilizers, petroleum products (like gas and oil leaks from automobiles and trucks), or wild and domestic animal wastes.

For example, a research study of pollution in the Arkansas River in 2002 determined that much of the river's pollution problem was caused by wild animal manure that got into the river when it rained on the fields and lawns that had been visited by local geese. It was fairly easy to discover what was polluting the river, but it would be almost impossible to find exactly which fields and lawns the pollution was coming from.

Discuss point and non-point source pollution, and make a list of possible sources of both types of pollution in the community. Brainstorm ways to reduce local non-point source pollution sources. Some suggestions might be:

Be careful not to spill fuel when filling the car
Fix oil leaks in car, truck, motorcycle, lawn mower and tractor engines
Read and follow directions on garden fertilizers and pesticides,
Take toxic products (like paint) to the hazardous waste recycle center

PROCEDURAL STEPS

1. Roll the wire mesh into a 1" to 2" cylinder that is 8" long and fasten it with one piece of clear tape
2. Hold the cylinder in the center of the plastic container. Pour the stones into the container so they go around, but not into, the cylinder. The cylinder should be standing up in the center of the container when you are finished.
3. Pour sand on top of the stones until the container is 2/3 to 3/4 full of sand. Do not pour sand inside the mesh cylinder! This cylinder represents a drinking water well.
4. Fill the spray bottle with clear water and "rain" on (spray) the surface of the land until you can see a little water in the well. This represents the drinking water that comes from an aquifer.