FROM GROUND TO WATER

SUBJECTS:
Language Arts, Science (Physical Science, Earth Science)
TIME:
1 class period
MATERIALS:
Student Sheets: The Hidden Resource – Groundwater. Keeping it Safe Keeping it Protected

OBJECTIVES

The student will do the following:

1. Define groundwater.

2. Describe some problems involving groundwater.

3. Discuss ideas relating to groundwater issues.

BACKGROUND INFORMATION

Groundwater begins with precipitation that seeps into the ground. The amount of water that seeps into the ground will vary widely from place to place depending on slope of the land, amount and intensity of rainfall, and the type of land surface.

Many people think of groundwater as underground lakes or streams; however, groundwater is simply water filling spaces between rock grains or fractures and fissures in rocks. A body of rock or sediment that can yield water in a usable quantity is called an aquifer.

Rain and snowmelt percolating down through the soil are the sources of groundwater. Plants consume much of the water that enters the soil, and a small amount is held on the soil grains. Some water in the soil evaporates, and some flows out of the soil into lakes

and rivers.

Groundwater is usually in very slow motion. The rate of groundwater flow is determined by the slope of the water table and the sizes of the pores among the rock and soil particles.

Groundwater does not occur all the way to the core of the Earth. Beneath the water-bearing rocks everywhere, at some depth the rocks are water-tight. This depth may be a few hundred feet or, more than likely, tens of thousands of feet.

Terms

aquifer:
porous, water-bearing layer of sand, gravel, and rock below the Earth's surface; reservoir for groundwater

fault:
a fracture in the Earth's crust accompanied by displacement of one side of the fracture with respect to the other

fracture:
a break in rock that may be caused by compressional or tensional forces

groundwater:
water that infiltrates into the Earth and is stored in usable amounts in the soil and rock below the Earth's surface; water within the zone of saturation

pore:
a passage; channel; a tiny opening, usually microscopic

saturated zone:
a portion of the soil profile where all pores are filled with water. Aquifers are located in this zone. There may be multiple saturation zones at different soil depths separated by layers of clay or rock.

saturation:
being filled to capacity; having absorbed all that can be taken up

surface water:
precipitation that does not soak into the ground or return to the atmosphere by evaporation or transpiration. It is stored in streams, lakes, rivers, ponds, wetlands, oceans, and reservoirs.

transpiration:

process in which water absorbed by the root systems of plants moves up through the plants, passes through pores (stomata) in their leaves or other parts, and then evaporates into the atmosphere as water vapor; the passage of water vapor from a living body through a membrane or pores

unsaturated zone:

a portion of the soil profile that contains both water and air; the zone between the land surface and the water table. The soil formations do not yield usable amounts of free-flowing water. It is also called zone of aeration and vadose zone.

water table:

upper surface of the zone of saturation of groundwater

ADVANCE PREPARATION

Have copies of Student Sheets ready for class distribution.

PROCEDURE

I. Setting the stage

A. Have terms and definitions on the board.

B. Have students write terms and definitions in journals if vocabulary words are to be used as part of an overall unit word study.

C. Give students copies of one or more of the Student Sheets that are to be used.

D. Allow for independent reading time or assign sections to be read individually.

E. Have a class discussion of handouts led by teacher or student. Have on hand several leading questions that may be developed in class discussion; these could come from Background Information.

II. Activity

A. Read the Student Sheets on Groundwater. Write a newspaper article addressing groundwater problems.

B. Create a three-frame comic strip addressing one problem involved in groundwater contamination.

C. Compose a well-written business letter (using the form suggested in your English textbook) to an official in the area, or ask one in the local state agency to speak to the class concerning groundwater in the area. Follow up with a thank-you letter.

D. Write a newspaper story relating your findings of the groundwater situation in your area.

E. Prepare a lesson plan for presentation to a fifth-grade class in which groundwater issues are addressed. Include terms and definitions, questions for discussion, and a short follow-up quiz.

III. Extensions

CRYPTOQUOTE: Here's how it works: One letter stands for another letter; double letters, single letters, punctuation, and frequency of use are all clues. Usually E is the most frequently used letter, and THE is the most frequently used three-letter word. Have fun!

F W X B P Z R F P X Q W Z W X P T L Z J J Z A W

Y F J J A W B A H J Z M K Z Q H V A R J F W Q H Z J J B

F W Q A W X I K W Q V X Q L Z J J Z A W Y F J J A W B

H V A R J Z M K Z Q Z R U A K W Q R X W P B F W W K F J J T

J X F O Z W P A Y V A K W Q- S F P X V Z W P I X

K W Z P X Q B P F P X B.

Solution:

An estimated 90 billion gallons of liquid from landfills and 100 billion gallons from liquid impoundments annually leak into groundwater in the United States.

RESOURCES

Arms, Karen, Environmental Science, Holt, Rinehart, and Winston, Inc., Austin, TX, 1996.

Fact Sheet on Water, U.S. Environmental Protection Agency, Washington, D.C. (pamphlet).

“Ground Water: The Underlying Issue”, Alabama Geological Survey, Tuscaloosa, AL (pamphlet).

The Hidden Resource - Groundwater

Every day Americans rely on a resource that is "hidden" in its natural surroundings. Hidden beneath layers of soil and rock is the Earth's largest freshwater supply: groundwater. The estimated supply of groundwater in the lower 48 states is 65 quadrillion gallons or about 4 times the amount of water in the Great Lakes. It is the source of water for about half of the U.S. residents and nearly 97 percent of the rural population.

Groundwater originates as precipitation. It seeps into the ground, filling the spaces and pores between soil particles or the fractures and fissures in rocks. The underground area where all the pores and spaces are filled with water is called the saturated zone. Different geological formations hold varying amounts of water, but those that yield water in usable quantities are called aquifers. Usually, groundwater flows slowly through an aquifer; the rate can be as little as half an inch per year. The flow can be considerably faster in limestone caverns, volcanic lava tubes, or large rock formations where groundwater may resemble underground streams.

As water travels through the soil and rock, it picks up water-soluble materials and carries them along. Some of the materials in groundwater occur naturally, but many constituents in groundwater are the result of human land use activities. Different soils have different capacities to filter and absorb wastes. However, once groundwater is contaminated, it is difficult and may be impossible to clean up. When possible, cleanup is very expensive and may require many years.

In many geological formations, groundwater moves so slowly that contamination can remain undiscovered for years until the contaminated groundwater is brought to the surface by springs or wells. During that time, the pollutants can spread and contaminate large volumes of otherwise usable groundwater.

Potential sources of contaminants that threaten groundwater in the United States include the following:

- ~23 million septic systems
- ~390 million tons of municipal and industrial waste in 6,000 landfills
- ~1.7 million active oil and gas wells and ~1million abandoned wells
- ~72,000 active coal and mineral mines; ~60,500 oil and gas; ~1,500 metal mines; ~5,000 coal; ~6,000 active non-metal
- ~1.1 billion pounds of pesticides used each year; 660 million pounds of Alachlor and

Atrazine used per year

- ~50 million tons of fertilizer used each year
- ~306 million gallons of improperly disposed motor oil
- ~1.2 million underground storage tanks
- ~7.4 million tons of deicing salts applied to highways each winter; Snow Belt states receive 100 metric tons per road mile during the winter

KEEPING IT PROTECTED

An estimated 90 billion gallons of liquid from landfills and 100 billion gallons from liquid impoundments annually leak into groundwater in the United States.

Listed below are some of the ways to make sure that future generations will have clean, safe groundwater supplies.

- Have your septic tank pumped out every three to five years.
- Do not store pesticides, fertilizers, and herbicides near a well.
- Make sure abandoned wells are properly filled in and sealed.
- Store home-heating oil in an above-ground storage tank where leaks can be easily detected.
- Use fertilizers and pesticides on lawns and gardens sparingly and follow all label directions for mixing, use, and disposal of empty containers.
- Report chemical or toxic spills on land, in the air, or in the water by calling the 24-hour National Response Center toll-free at 800-424-8802.
- Do not pour toxic or hazardous substances into sinks or toilets, on the ground, or into sinkholes.
- Collect used motor oil and recycle it at used-oil collection centers or service stations.
- Cover your wellhead with a cap and grade the soil around the wellhead so that runoff water is diverted away from the well.
- Test your well water for bacteria and nitrates once a year.

KEEPING IT SAFE

Everyone has a role to play in keeping our water supplies safe. Everyday activities affect water quality. By being cautious about the use of hazardous substances - pesticides, fertilizers, herbicides, paints, fuels - and the disposal of all types of waste, every citizen can help keep our water resources safe and clean.

Consider some of the following alternatives to hazardous household chemicals and products:

- Use lotions or gels instead of aerosol sprays.
- Use rechargeable batteries.
- Use 1 part vinegar to 32 parts water to wash floors.
- Use a mixture of salt and lemon juice to clean copper.
- Use dry cornstarch or baking soda as a rug cleaner.
- Use non-phosphate detergents.
- Use cedar chips as an alternative to moth balls.
- Use 2 tablespoons of vinegar to 1 quart of water as a window cleaner.