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Build A Model Aquifer

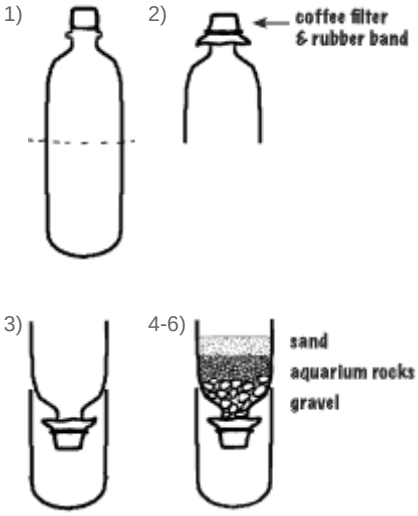
This activity shows how surface water percolates through layers of sand, rocks and gravel to the aquifer from which we draw our delicious drinking water.

For this activity you will need:

- A plastic drinking water bottle
- A rubber band
- Some clean gravel
- A coffee filter
- Some clean sand
- Some clean aquarium stones
- measuring cup
- an adult helper
- food coloring or Kool Aid powder
- an xacto knife (for adult use only)

Container Preparation:

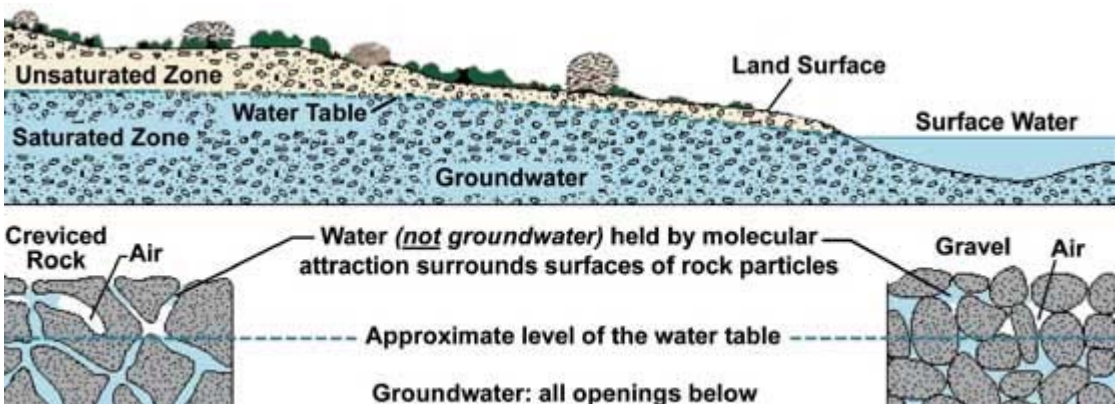
1. Have an adult help you with this step! Have your adult helper cut the plastic bottle in half with the xacto knife.
2. Wrap the coffee filter or cheese cloth around the mouth of the bottle and secure it with the rubber band.
3. Turn the top half of the bottle upside down and set it inside the bottom half, so the mouth with the filter is pointing towards the bottom.
4. Place gravel into the container until in makes a layer approximately 1" high.
5. Now fill the container with aquarium stones until it makes another 1" layer on top of the gravel layer.
6. On top of the aquarium stones, make a 1" layer of sand. These layers of sand, rocks and gravel represent the soil makeup of the desert we live in.

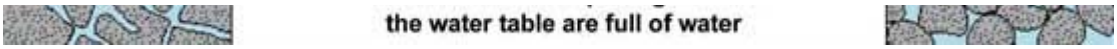


Procedure and Observations:
Start with a 1/3 cup of clean water. Mix some soil into the water and slowly pour it into your container.

EXERCISE 1: Watch as the water filters down through the sand, rocks and gravel, and finally into the bottom of the container. This process is called **percolation**. Look at the water in the bottom of your container. Does it still have soil in it? The layers of sand, rocks and gravel in the ground act as a natural filter, trapping soil particles as the water flows through. Take the water from the bottom of your container and pour it back into the measuring cup. Does it reach the 1/3 cup mark? Some of the water is retained in the sand, rocks and gravel. The amount of water that can be held in the soil is called **porosity**. The rate at which the water flows through the soil is its **permeability**. Different surfaces hold different amounts of water and absorb water at different rates. Is more water held in the sand, rocks or gravel?

Exercise 2: Empty the water out of the bottom of the container and then place the top half containing the sand, rocks and gravel back into the bottom half. Slowly pour one cup of water into your container, and let it percolate into the bottom. If the water level is below the mouth of the top half of the bottle, slowly add more water until the water level reaches into the gravel. Notice the area of gravel that is completely full of water - this area is **saturated**. Now look at where the water levels off at the top of the saturated area. The level at which the ground above is unsaturated and the ground below is saturated is called the **water table**.





map courtesy: United States Geological Survey

An **aquifer** is a water-bearing stratum of permeable rock, sand, or gravel. The study of water flow in aquifers and the occurrence, distribution, and effect of groundwater is called **hydrogeology**. The process of water from rain, rivers, streams or melting snow flowing down through the layers of sand, rocks and gravel into an aquifer is called **recharge**.

Groundwater is water flowing within aquifers below the water table. Within aquifers, the water flows through the pore spaces in gravel, rocks, sand, silt, clay and the fractures of rocks. Groundwater is recharged from, and eventually flows to, the surface naturally; natural discharge often occurs at springs and seeps and can form oases or swamps. Groundwater is also often withdrawn for agricultural, municipal and industrial use through man-made **wells**.

Exercise 3: Empty the water out of your container bottom, and place the top half back into the bottom half again. Sprinkle a few drops of food coloring or Kool Aid powder on top of the sand, slowly pour 1 cup of water into the container, and let it percolate to the bottom. What happens to the food coloring? What color is the water in the bottom of the container? In this exercise the food coloring represents oil, pesticides, faulty septic tank leakage, and other such contaminants which can pollute the groundwater from which we draw our drinking water. You can see how important it is to protect our groundwater from sources of pollution. Just as water moves in the water cycle (from groundwater to streams, lakes and rivers and vice versa, etc.), so can water pollution. Contaminated groundwater can pollute streams, lakes and rivers, and contaminated streams, lakes and rivers can pollute groundwater.

A **watershed** is the land area that drains water from rainfall or snowmelt to a stream, river, lake, or ocean. Watersheds are in hilly or mountainous areas as well as in flat areas, and come in many shapes and sizes, from a small area that drains into a pond to millions of square miles like the land that drains into the Gulf of Mexico. Desert Hot Springs is part of the Whitewater River watershed.

It's important to take care of watersheds because they provide homes and water for all living things. As water drains into the lowest area of a watershed, it will pick up soil and other small particles such as oil, road salt, fertilizers, pesticides, or other **pollutants**. All of these small particles are then carried into our waterways where they accumulate and become hazards for all who depend on this water.

Pollution occurs when a substance changes the physical, chemical, or biological properties of the water, air or land and makes it harmful to use (**contamination**). Water pollution is pollution that has entered our lakes, ponds, streams, oceans, etc. and is unhealthy for the plants and animals that depend on this water to live. This includes people too! Think of the many ways in which we depend on water to live. Water equals life!

Pollution can be divided up into two basic categories - point source pollution and non-point source pollution.

Point Source Pollution: This is pollution that comes from a specific "point" or place, such as a pipe. It is easier to find where point source pollution is coming from, because you can normally just follow the pollution back to where it is flowing or leaking from. Examples: Pipes that either carry liquids or smoke away from some place, such as a factory, a sewage treatment plant, or even from our homes.

Non-Point Source Pollution: Non-point source pollution describes the pollution that water picks up as it flows across a surface such as our lawns, streets, farm fields, or a construction site. After it rains, water travels across these surfaces, picking up "stuff" along the way and then flows into streams, drainage ditches, or soaks down into the ground. Examples: Pesticides, herbicides (weed killers), fertilizers, or soil from farm fields and lawns; motor oil and other chemicals that run off of streets; chemicals that seep into the ground from landfills; bacteria and nutrients from farm animals, pets, or faulty septic tanks.

The **water cycle** is a continuing cycle of water flowing from land and sea (or any body of water) to the atmosphere and back again. Water **evaporates** from oceans, lakes, and streams into the atmosphere, and transpires from plants. **Transpiration** is the evaporation of water into the atmosphere from the leaves and stems of plants. Plants absorb water through their roots and this water can originate from deep in the soil. For example, some plants have roots that are very shallow and spreading, while some desert plants have roots that extend 20 meters into the ground. Plants pump the water up from the soil to deliver nutrients to their leaves. This pumping is driven by the evaporation of water through small pores called **stomates**, which are found on the undersides of leaves. Later the water returns to the land in the form of rain or snow, where it evaporates again or runs off into the streams and rivers (watershed area) or soaks down into the ground to become groundwater. Groundwater eventually seeps into streams and lakes or flows to the oceans and evaporates...and the cycle begins again.