Imagine a rock with bubbles trapped inside it. There are two possibilities. First, the rock might be full of bubbles, but the bubbles aren't connected to each other. Even if all the bubbles were filled with water, that water couldn't get out; it couldn't move THROUGH the rock. The second possibility: the bubbles ARE connected. Water could flow from bubble to bubble, in one side and out the other. Water could move through the rock as it could through a sponge.

Permeability/impermeability

This second kind of rock, the one that water can move through, is called a PERMEABLE rock. Water is able to PERMEATE (move through). The rock that water cannot move through is called IMPERMEABLE. The "im-" means "not."

Sedimentary rock

Water squeezes between the grains of sand in sandstone. Sandstone is called a SEDIMENTARY rock because it's made of compressed sediment (sand). Sedimentary rocks can be good places to look for groundwater.

Demonstration 2: permeability

PURPOSE: To understand permeability (how easily water can move through a rock or soil)

MATERIALS:
- 8 plastic cups
- graduated cylinder
- gravel
- clay
- soil
- colored water
- water
- sand
- stopwatch

PROCEDURE: Punch four small holes in the bottom of each cup. Each cup will receive a different earth material or mixture of materials

cup 1: clay	cup 5: gravel + sand
cup 2: sand	cup 6: soil + gravel
cup 3: gravel	cup 7: soil + sand
cup 4: soil	cup 8: soil + gravel + sand

For each of the cups requiring a mixture (cups 5-8) use large containers to mix the materials thoroughly before you begin the next step.

Fill each cup with its required mixture (or plain material) so that the level of the earth material is 1" from the lip of the cup. Number each cup or label with mixture contained in each. Pour 25cc of water into each cup (if using very large cups, use 50cc water instead). (This first water will be drained and discarded; the purpose is to make sure all materials are saturated BEFORE timing how fast excess water -- the second pouring -- travels through. Otherwise, "thirsty" earth materials will retain some of the timed water, and you won't get an accurate reading.)

Set the cups on pencils or matchsticks so the water can drain through the holes thoroughly. Wait 10 minutes.

The next part needs two people. One works the stopwatch and the other pours. With stopwatch ready, pour in 25cc of colored water. Start watch as soon as all the water has been poured in (quickly). Stop the watch when the first drop of colored water appears. Record times for each cup.

RESULTS:

clay =______seconds
sand =______seconds
gravel =______seconds
soil =______seconds

CONCLUSION: The different sizes and shapes of the particles create different sized pore spaces. The ease with which water passes through (permeability) in unconsolidated deposits like the ones in this demonstration is determined by the smallest of the gaps, as this is where water would start to back up. In a solid rock, however, water's ability to pass through depends on how well the pores are connected to each other.

QUESTIONS:

1. Which earth material was the most permeable? The least?
2. How did mixtures fare against single-material cups?
3. All of the earth materials used in this demonstration were "unconsolidated" so that permeability was a function almost entirely of the materials' porosity. How is this different from permeability in a solid?
4. The rate of water travel = soil distance divided by time travelled. Find the rate for each cup.