CAPILLARITY

INTRODUCTION

The ability of various soils and rocks to allow water to move up through them is capillarity. Capillarity is somewhat dependent upon a rock's porosity and permeability. The forces involved in capillarity are gravity pulling downward on the water, and attraction between water molecules and the molecules of the rock. In this investigation, you will investigate the porosity of earth materials.

OBJECTIVES - - Upon completion of this activity, the student should be able to . . .

1. Define capillarity
2. Measure the capillarity of different types of earth materials
3. Explain how capillarity affects fluid movements in the earth's crust
4. Explain how porosity, permeability, retention, and capillarity are interrelated (after completing the four activities in this set of activities)

STATE STANDARDS ADDRESSED

12.E.2a -- Identify and explain natural cycles of the earth's land, water and atmospheric systems
12.E.2b -- Describe and explain short term and long term interactions of the earth's components
12.E.3a -- Analyze and explain large-scale dynamic forces, events and processes that affect the earth's land, water, and atmospheric systems.

MATERIALS NEEDED

1 plastic column (with drain tube and pinch clamp)
1 ring stand
2 burette clamps
1 500 mL beaker
1 meter stick
100 mL of pea gravel*
100 mL of sand
1 graduated cylinder (100 mL)
water supply

* Aquarium gravel can be easily substituted for pea gravel

PROCEDURES

A. Attach the two burette clamps to the ring stand. Place one clamp near the middle of the ring stand, and place the other clamp near its top. Open both clamps as wide as they will widen.

B. Place the plastic column in the burette clamps, and tighten the clamps. Be sure the tube-end of the plastic column is down. Also, be sure the drain tube is clamped closed (using the pinch-clamp). The bottom of the plastic column should be high enough above the base of the ring stand that you can easily move the 500 mL beaker beneath it (to catch water coming out of the plastic column). See Figure 1 on the next page.

C. Using the 100 mL graduated cylinder, measure out 100 mL of pea gravel.

D. Carefully pour the pea gravel into the plastic column.

E. Fill the beaker with 500 mL of water. You may need to use the graduated cylinder to measure it carefully. Note that you will not be pouring the water into the plastic column.

F. Remove the pinch clamp on the drain tube at the bottom of the plastic column. Then, slightly loosen the burette clamps so you can lower the plastic column toward the base of the ring stand – but don't lower it yet.

G. Place the beaker of water underneath the plastic column. Then, lower the plastic column so the drain tube is down into the water. Keep lowering the plastic column until the bottom of the column is just about halfway down into the water in the beaker. Check to be sure the drain tube is not crimped. The part of the plastic column beneath the water level is the **saturation zone**. Measure the size (length in cm) of the saturation zone. Record this in the space below:

Saturation Zone (cm): _____

H. Soon, you should see water moving up into the plastic column from the beaker. After five minutes, use the meter stick to measure (in cm) how high into the column the water moved. Record this distance in the Data Table on the next page.

I. Repeat Procedures A-H, but this time use sand instead of pea gravel. Be sure to record your information in the Data Table.

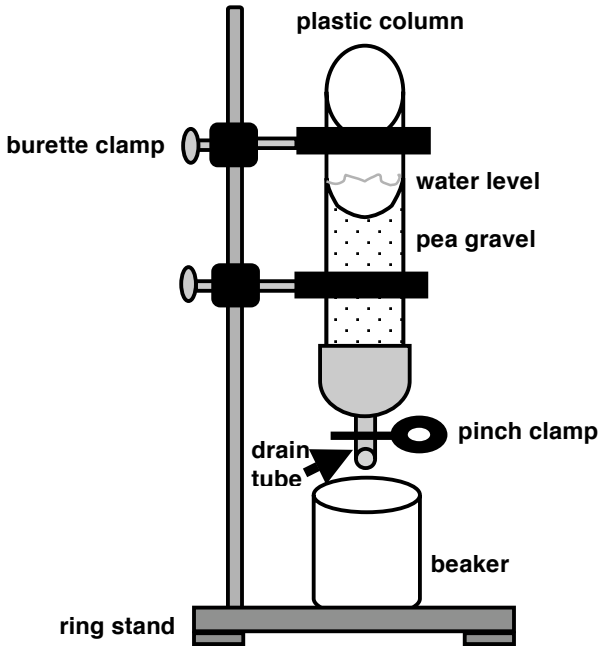

Figure 1

Data Table for Porosity

Earth Material Size	Capillarity (cm rise of water in column)
Pea Gravel (12 mm diameter)	
Sand (7 mm diameter)	

QUESTIONS

1. Compare the capillarity of pea gravel and that of sand. Which size of particle can provide the most capillarity for water?
2. If you wanted to find an aquifer with the best capillarity, which earth material would you seek: one with particles having a larger diameter of those having a smaller diameter? Explain your answer.
3. Which type of rock do you think would have the most capillarity: sandstone, limestone, or granite? Explain your answer.
4. Explain the relationship between the pore openings of an earth material and the capillarity of that material.

5. Review the results you obtained from each of the four activities (porosity, permeability, retention, and capillarity), and answer the following questions:

   For an earth material (soil, rock, etc.), what is the relationship between (or how does one affect the other) . . .

   a. porosity and permeability

   b. porosity and retention

   c. porosity and capillarity

   d. permeability and retention

   e. permeability and capillarity

6. Explain why porosity, permeability, retention, and capillarity are important to consider when comparing one aquifer to another.

7. How might we protect an aquifer from a landfill or waste well? Explain your answer using what you know about porosity, permeability, retention and capillarity of earth materials.

RESOURCE:

American Geologic Institute. (1967). *Investigating the earth*. Boston: Houghton Mifflin Company.