POROSITY – Activity 1

INTRODUCTION

The ability of various soils and rocks to hold water depends on several factors. One of those is porosity. Depending upon how porous a particular soil or rock is, it may act as a water-holding layer called an aquifer. Some rocks act as cap rocks, keeping water inside the aquifer layers. 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 porosity
2. Measure the porosity of different types of earth materials
3. Explain how porosity 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
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 graduated cylinder with 100 mL of water, and then pour water from the graduated cylinder into the plastic column. Keep adding water until the upper surface of the pea gravel is just barely covered with water.

F. Measure how much water is left in the graduated cylinder. Subtract this amount from the original 100 mL and record this volume in the Data Table on the next page. This volume of water is a measure of the porosity of the gravel.

G. Empty the plastic column of the pea gravel and water. Place the pea gravel in a container your teacher provides, so it can dry.

H. Next, repeat Procedures A-G, but this time use sand rather than pea gravel. Be sure to record the measured volume of water in the Data Table on the next page. This volume of water is a measure of the porosity of the sand.

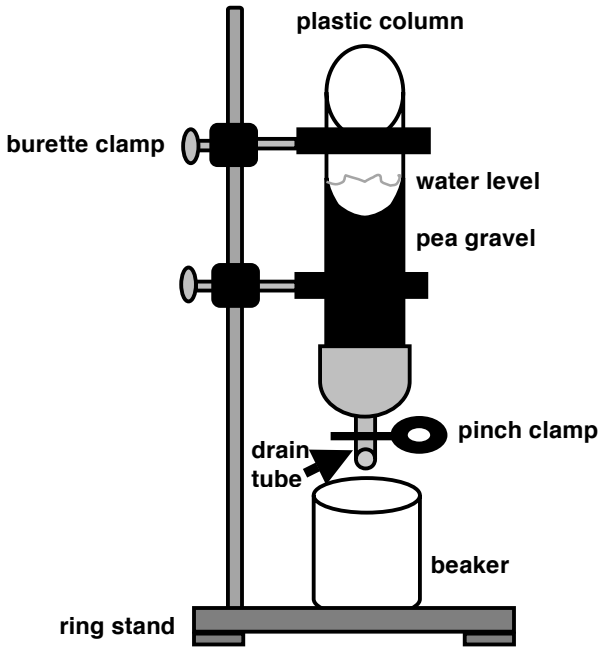

Figure 1

Data Table for Porosity

Earth Material Size	Porosity (mL of water held in the material)
Pea Gravel (12 mm diameter)	
Sand (7 mm diameter)	

QUESTIONS

1. Compare the porosity of pea gravel and that of sand. Which size of particle can hold the most water?
2. If you wanted to find an aquifer to use as a water supply (based on porosity), 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 be most porous: sandstone, limestone, or granite? Explain your answer.
4. Explain why it may be necessary to have a cap rock above an aquifer.
5. Do you think it may be necessary to have an impermeable layer of rock beneath an aquifer? (Hint: "impermeable" means water cannot pass through it.) Explain your answer.

RESOURCE:

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