Permeability

Background:

How does water move through materials such as rocks? Permeability is the measure of how easily water can flow through a material (like rocks, soil, clay or sand). Water in the aquifer is replenished during recharge events. Recharge adds water to the groundwater system when rainfall, melting snow, surface water, or water from a creek or lake soaks in through the soil and rocks.

Objective:

Students will measure the permeability of water through 4 different substrates (sand, gravel, pebbles and soil) and compare the results.

Materials:

1 paper cup with holes punched in the bottom, 1 coffee filter, 1 of the types of substrate (sand, gravel, pebbles and soil), a stop watch, 1 beaker, 1 graduated cylinder

Procedure:

1. Place the coffee filter into the cup.
2. Put 100 mL of sand, gravel, pebbles or soil in the cup. (Each group will be assigned a different substrate.)
3. Place the cup over an empty beaker, so you can measure the amount of water filtering through the substrate.
4. **Be ready to start timing flow soon.** Slowly pour 100 ml of water from the graduated cylinder into the plastic cup with one of the substrates. Keep the water level slightly above the top of the substrate in the plastic cup.
5. **START TIMING THE FLOW** when the water starts to come out of the plastic cup and into the beaker.
6. **STOP TIMING THE FLOW** when the water level reaches 100 mL or the flow stops.
7. Share your data.
8. Average the times and complete the calculations **using the average time** (mean).
9. Answer the questions in complete sentences and complete the drawings on the back of the lab sheet.

Permeability Lab Sheet

Name:_____ Class Period: _____ NB#:_____

Question: Which substrate (sand, gravel, pebbles or soil) has the highest permeability? Why?

Prediction: _____

Data Table:

	Trial 1	Trial 2	Trial 3	Average
Sand				
Pebbles				
Gravel				
Soil				

Calculations: Permeability = volume of water (mL) divided by time in minutes

Sand: 100 mL / _____ minutes = _____ mL per minute

Pebbles: 100 mL / _____ minutes = _____ mL per minute

Gravel: 100 mL / _____ minutes = _____ mL per minute

Soil: 100 mL / _____ minutes = _____ mL per minute

Conclusions: (look over your data and your background information)

1. Which substrate (sand, gravel, pebbles or soil) had the greatest permeability (most permeable)?

2. Which substrate (sand, gravel, pebbles or soil) had the least permeability (least permeable)?

3. How does the data support or not support your prediction?

4. How does porosity relate to permeability?

Complete the drawings on the back of this page.

Porosity

Background:

How much water can a material hold? Porosity is the measure of the void spaces in a material such as soil, sand, or rock. Porosity is measured as a percentage of open space or pores in a material and can be calculated using a simple formula.
An aquifer is an underground layer of rock that stores water. The amount of water that the aquifer can store is directly related to its porosity.
The substrates (sand, gravel, pebbles or soil) in this lab represent aquifers.

Objective:

Students will measure the porosity of 4 different substrates (sand, gravel, pebbles or soil) and compare the results.

Materials:

1 plastic cup, 75 mL of 1 of the types of substrate (sand, gravel, pebbles or soil),
1 graduated cylinder, and calculator.

Procedure:

1. Write your prediction.
2. Fill the plastic cup with one of the following:
75 mL sand, 75 mL rock, 75 mL clay, 75 mL soil
3. Fill your graduatated cylinder with 100 mL of water.
4. Record 100 mL on your lab sheet as your start volume.
5. Slowly pour the water from the graduated cylinder into one of the substrates in the plastic cup until there is a very thin layer of water covering the substrate.
6. Read the remaining volume of water in the graduated cylinder and record the volume as the finish volume.
7. Share data and complete the calculations.
8. Answer the questions in complete sentences and complete the drawings on the back of the lab sheet.

Porosity Lab Sheet

Name:_____ Class Period: _____ NB#: ____

Question: Which substrate (sand, gravel, pebbles or soil) has the highest porosity? Why?

Prediction: _____

Data/Calculations:

Pore Space Volume = Start Volume – Finish Volume

% Porosity = (Pore Space Volume / Substrate Volume) x 100

	Start Volume	Finish Volume	Pore Space Volume	Substrate Volume	% Porosity
Sand					
Pebbles					
Gravel					
Soil					

Conclusions:

1. Which substrate has the highest porosity? _____

2. Which substrate has the lowest porosity? _____

3. How does the data support or not support your prediction?

4. Combining what you have learned about **porosity** with what you've learned about **permeability,** why would rock be a poor filter for water?

5. Which material would make a good filter? Explain why.

6. Which material would make a good aquifer? Explain why.

Complete the drawings on the back of this page.