Name --____________________ E-S # -- __ Due Date-- _________

Groundwater Movement Lab

Pre-lab:

1. What is porosity? ____

2. Round particles have a ____________ porosity and flat particles have a __________ porosity.

3. Tightly packed particles have a ________ porosity and loosely packed particles have a _________ porosity.

4. What effect does size have on porosity? ____

5. What is permeability? ____

Materials:

For each group:

- 4 test tubes
- test tube rack
- 50 ml glass beaker
- gravel
- sand
- coffee filters
- 100 ml graduated cylinder
- small funnel
- potting soil

Hypotheses:

1. Which material will have the highest porosity? ____

2. Which material will have the lowest porosity? ____

3. Which material will have the highest permeability? ____

4. Which material will have the lowest permeability? ____

Part I: Porosity:

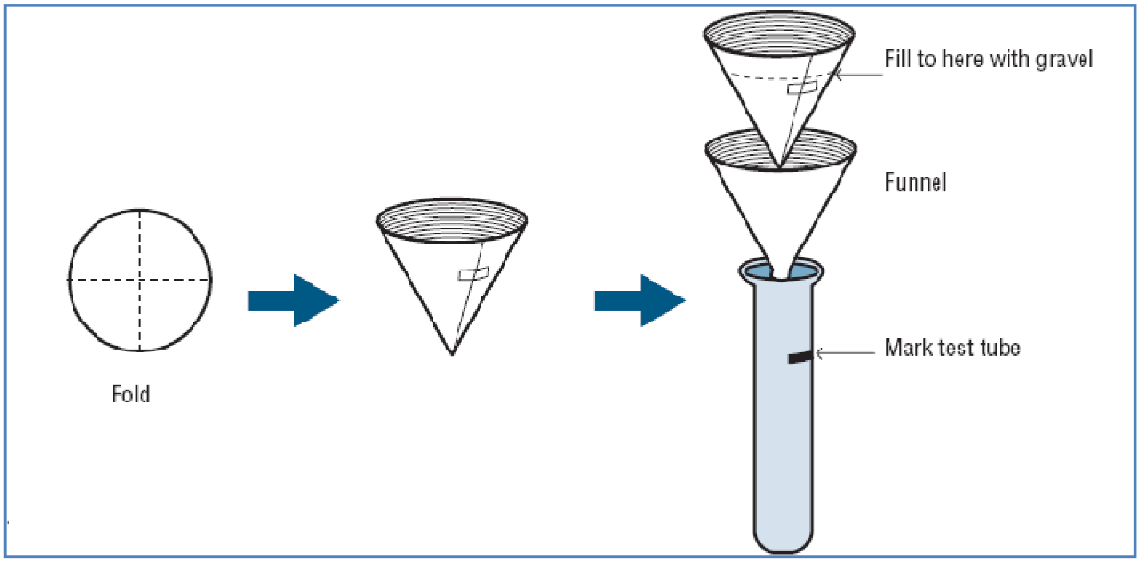
1. With a marking crayon, place a line about halfway up the side of a small beaker. Fill the beaker with water to the line. Pour this water into a 100 ml graduated cylinder. Record this volume on your data sheet under "total volume." Dry the beaker.

2. Fill the beaker with gravel to the line and fill the graduated cylinder to the 100 ml mark with water. Pour water from the graduated cylinder into the beaker until it reaches the line. Record the volume of water needed to saturate (fill the pores of) the gravel on your data sheet under "void volume." Repeat the investigation with samples of sand, soil and mixed (gravel & sand). *(Note: For potting soil make sure that the water has time to soak in completely.)* Record your results in the data table. Calculate the porosity.

$$Porosity\ (n) = \frac{Volume\ of\ the\ voids}{Total\ volume} \times 100\%$$

Part II: Permeability:

With a marking crayon, place a line about halfway up a test tube. Put the test tube in the rack and put the stem of a small funnel inside the test tube. Fold a circular filter paper into quarters, open it into a cone, and insert it into the funnel. Fill the cone with gravel to about ½ inch from the top. Measure the distance from the top of the funnel to the marker line and record this here _________ cm. This is the "distance traveled."



Pour water from a beaker into the filter. Using a clock, time how long it takes (in seconds) to fill the test tube to the line. Record the results on your data sheet under "time elapsed." Return the sample of gravel to the used gravel container and discard the filter paper. Repeat the experiment with sand, soil and mixed sediment. Calculate permeability.

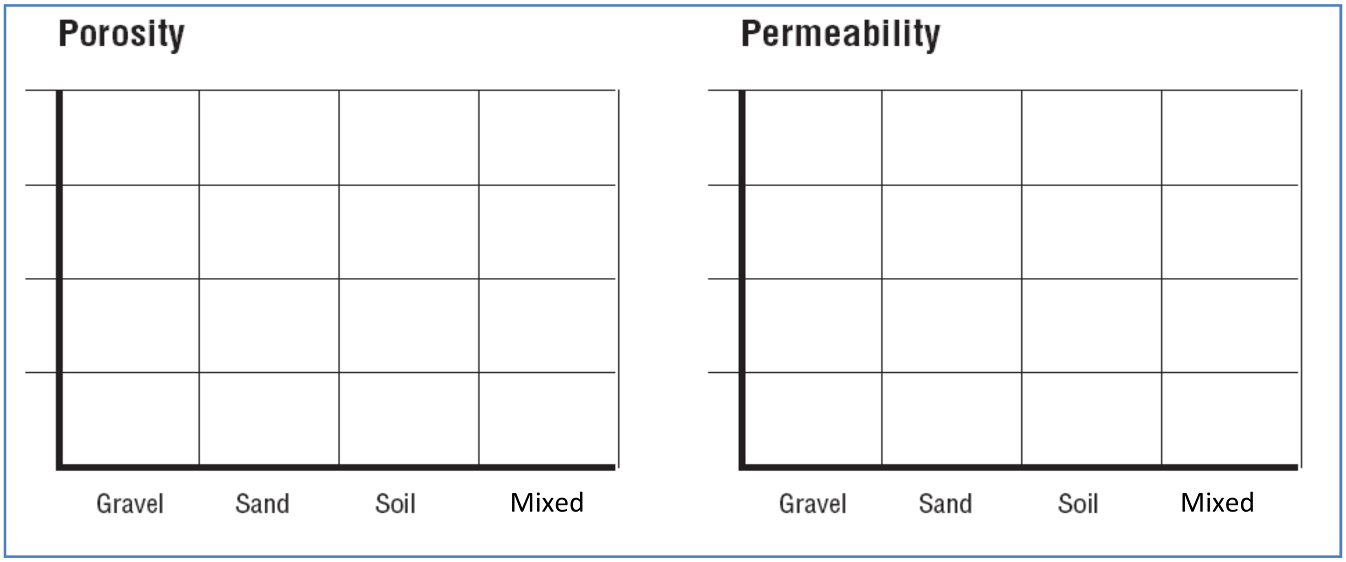
$$Permeability\ (k) = \frac{distance\ traveled}{time\ elapsed}$$

DATA TABLE

MATERIAL	***Void Volume (mL)***	***Total Volume (mL)***	***Porosity (%)***	***Time Elapsed (s)***	***Permeability (cm/s)***
Gravel					
Sand					
Soil					
Mix of Sand/Gravel					

Analysis:

1. Bar Graphs:



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1. Which material is most porous? ______________________________

2. Which material is least porous? _______________________________

3. Which material is most permeable? ____________________________

4. Which material is least permeable? ____________________________

5. Why are sandy soils relatively porous?

6. What would be an agricultural (i.e. economic) disadvantage to having a planting soil with high permeability?

7. Why would coal serve as a “good” aquifer?

8. Why would pumice <u>not</u> serve as a “good” aquifer?

9. Which would have a higher porosity, a well sorted sediment or a poorly sorted sediment? Explain.

10. Which would have a higher permeability, a well sorted sediment or a poorly sorted sediment? Explain.

11. What is the porosity of 200 mL of soil that can "hold" 80 mL of water? (SHOW WORK)

12. A student placed a dry 150 mL sample of sandstone in a 500 mL beaker filled with 400 mL of water overnight. When the sandstone was taken out, the water level dropped to 350 mL. What is the porosity of the sandstone? (SHOW WORK)

13. Why do parking lots tend to have a lot of puddles and "standing water?"

14. Which would have greater porosity and permeability: outwash (formed by glacial meltwater) or till (glacial deposits)? Explain your answer.

15. Can you accept or reject your hypothesis? Why or why not?

Lab created by C. J. Imperial, Guilderland H.S, November 2008.

This lab is a result of modifications from: a) Groundwater: A Vital Resource, Cedar Creek Learning Center and the Tennessee Valley Authority; b) How Groundwater Moves, Wisconsin Department of Natural Resources; c) GEO 435 course notes, Dr. B. K. Linsley, University at Albany, Fall 2001