Name: _______________________ **Earth Science**
Lab 24: Water Movement in the Ground **Date: ______**

Introduction:

Water supply is one the critical problems faced by mankind. Because of this growing problem, scientists are expanding their studies about the fate of water that infiltrates Earth.

Water that flows on the land surface in streams or lies in lakes and marshes is called surface water. The water that lies beneath the land surface, occupying the pores of the soil or bedrock is termed subsurface or ground water.

Objective:

You will observe the factors that affect the rate at which water passes through particles and those factors that affect how much water soil will retain.

Vocabulary:

Pore Space - ____

Permeability - ____

Water Retained - ____

Impermeable - ____

Reciprocal - ____

Infiltration - ____

Runoff - ____

Capillarity - ____

Ground Water - ____

Sorting - ____

Procedure

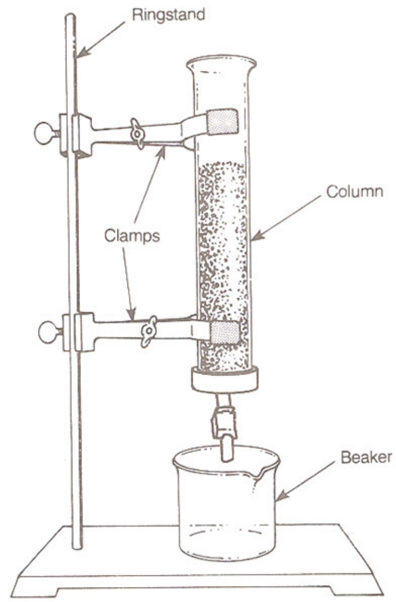
1. Close the clamp on the rubber tubing at the bottom of a plastic column and mount the column on the ring stand. Be sure the screen is in place at the bottom of the tube.

2. Place 300 mL of one sized particles in the column. Enter the size of your particles on your Report Sheet.

3. Measure 100 mL of water in a graduated cylinder. In order to time the "Wetting Front", pour about 20 mL of your water into the cylinder while your partner clocks the interval between the time the first water touches the top of the particles and the time when the *first* water reaches the bottom of the cylinder.

4. Enter that time on Row 1 of the Report Sheet. This time indicates the permeability of the material.

5. Continue to SLOWLY pour water into the column until the water is just up to the top of the particles. (Allow time for water to run down the sides after each addition so you find the true level).



6. On Row 3 of the Report Sheet record the total amount of water it took to just cover the beads. (100 mL minus the amount left in the graduated cylinder).

7. To determine the amount of water retained by the particles, drain the water into a dry beaker by opening the hose clamp. Measure this in a graduated cylinder and enter on Row 5 of the Report Sheet.

8. Empty the particles into the appropriate container and dry them and your tube.

9. Repeat these procedures twice, using different sized particles each time.

10. After you have taken all measurements do the necessary calculations to fill in Rows 2, 4 and 6 of the Report Sheet.
    a. Row 2: Find the reciprocal of the time by dividing as follows:

    $$\frac{1}{\text{Seconds (from Row 1)}}$$

    b. Row 4: Calculate the percent of pore space (porosity) by using the following formula:

    $$\text{\% Porosity} = \left(\frac{\text{Volume of Pore Space}}{\text{Total Volume of Particles}}\right) \times 100$$

    c. Row 6: Water retained = amount of pore space found in Procedure 6 minus amount of water drained into the beaker.

11. Using your data, make a graph of the variables Rows 2, 4, 6 on the vertical axis with particle size on the horizontal axis. Create a line graph with all your data points – experiment (Green), class average (Red) and theoretical (Blue) – on the same graph. Create a separate graph for each trial/particle size.

12. Observe the demonstration of capillarity provided by your instructor. Observe which particle size causes the water to move upward the farthest.

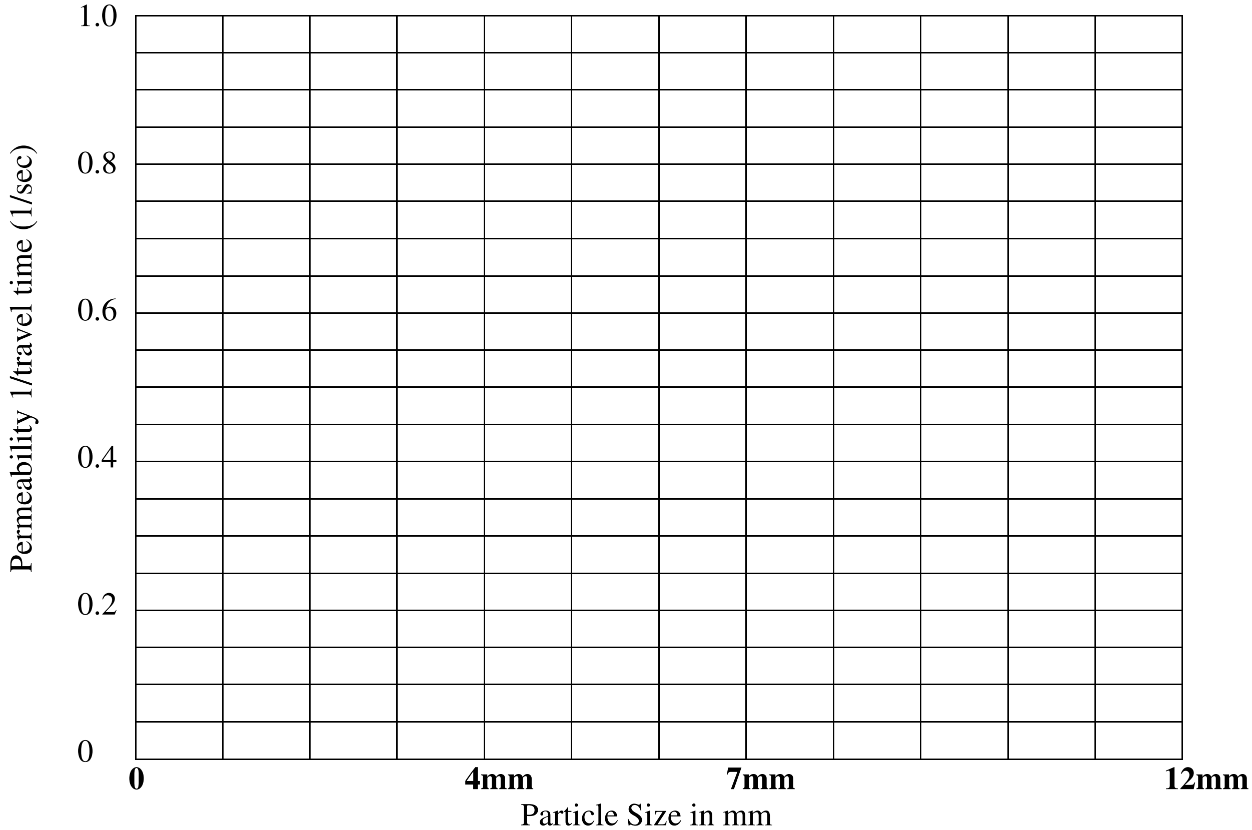
REPORT SHEET:

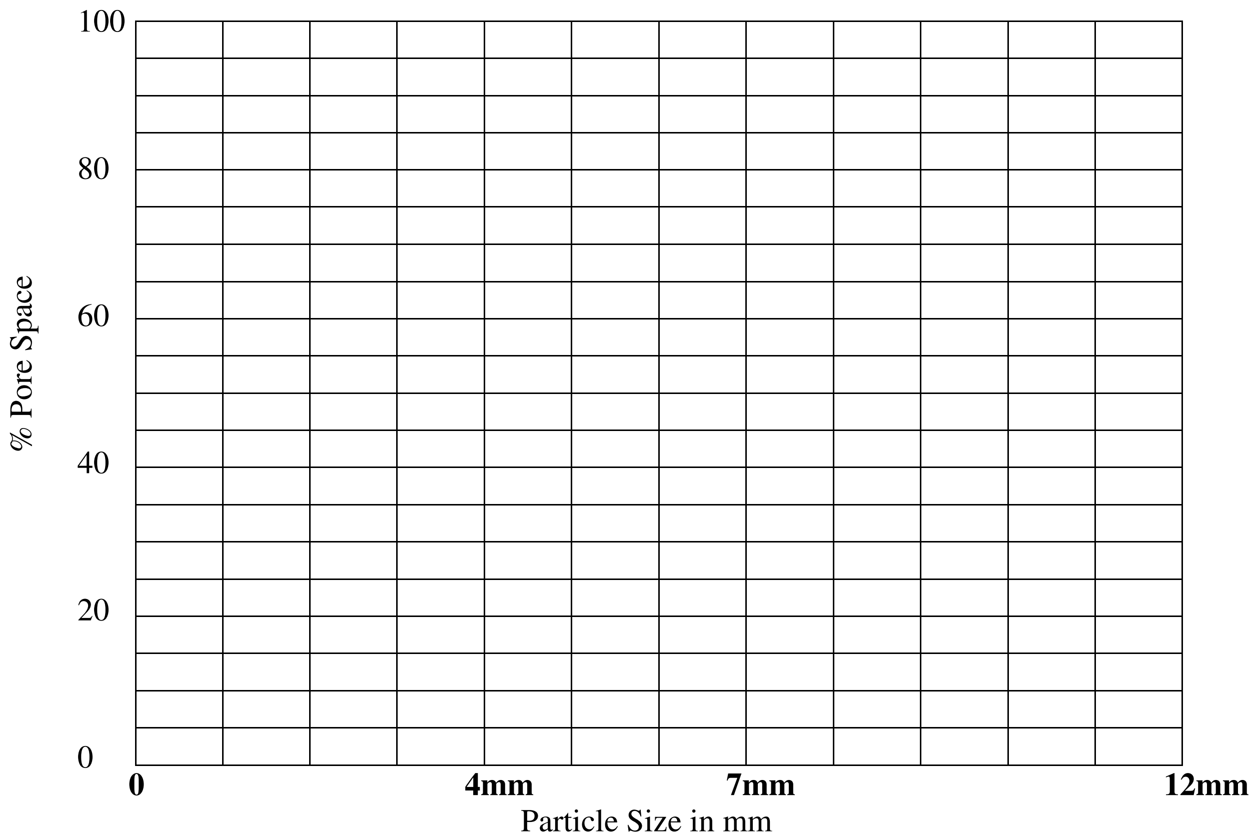
TRIAL 1 Particle Size 4 (mm)		Experiment	Class Average	Theoretical (300 mL)
Row 1	Wetting front travel time (sec)			3.6
Row 2	Reciprocal of travel time (1/sec) (Permeability)			.28
Row 3	Water required to fill pores (mL)			120
Row 4	Percent pore space			40%
Row 5	Water recovered (mL)			106
Row 6	Water retained (mL)			14

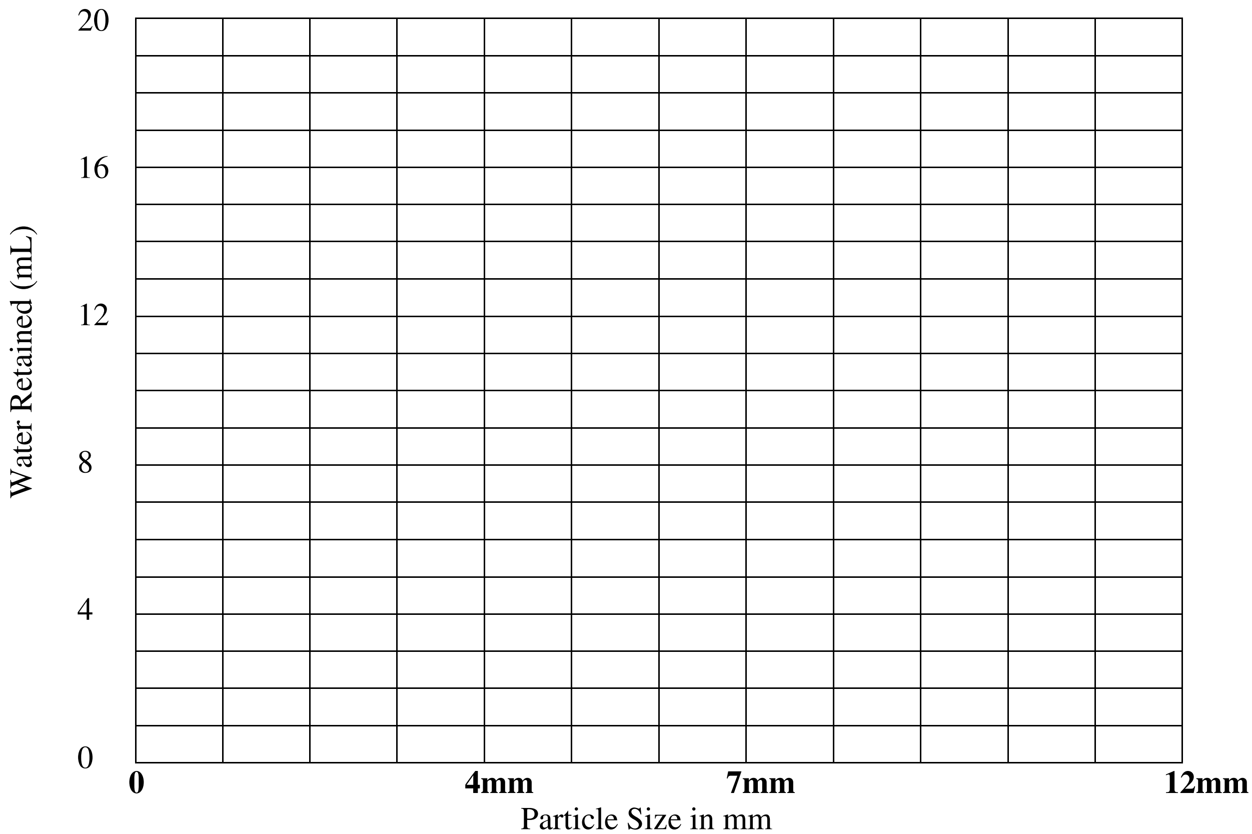
TRIAL 2 Particle Size 7 (mm)		Experiment	Class Average	Theoretical (300 mL)
Row 1	Wetting front travel time (sec)			3.0
Row 2	Reciprocal of travel time (1/sec) (Permeability)			.33
Row 3	Water required to fill pores (mL)			120
Row 4	Percent pore space			40%
Row 5	Water recovered (mL)			112
Row 6	Water retained (mL)			8

TRIAL 3 Particle Size 12 (mm)		Experiment	Class Average	Theoretical (300 mL)
Row 1	Wetting front travel time (sec)			1.5
Row 2	Reciprocal of travel time (1/sec) (Permeability)			.66
Row 3	Water required to fill pores (mL)			120
Row 4	Percent pore space			40%
Row 5	Water recovered (mL)			116
Row 6	Water retained (mL)			4

Water Movement in the Ground







Questions:

1. What is the effect of increasing particle size on each of the following:

   a. Percent of pore space:

   b. Water retained:

   c. Time necessary for infiltration:

   d. Rate of infiltration:

2. If an area has very small sized particles in the upper soil, what is the effect on each of the following:

   a. Runoff:

   b. Time of infiltration:

   c. Rate of infiltration:

3. Compared to the tube of large particle size, mixing the particles sizes in the tube will have what effect on:
   a. Its percentage of pore space?
   b. Its permeability?
   c. Its amount of water retained?
4. Which particle size would have the greatest capillarity?
5. How far underground can water infiltrate?
6. a) Identify a source of experimental error that would adversely affect your results.

   b) What would be the effect of that error on your data?

   c) How could you change your procedure to reduce this error?

Conclusion:
What factors control the amount of water that flows through the soil?