Name: _____ Class: _____

Student Worksheet: *Porosity and Permeability* - *Experiment #1*

Experiment #1 - Determining the Porosity of Soil Materials

1. Define porosity.

2. If not done already, obtain clear plastic cups or empty soda pop bottles. You will be filling cups with various types of soil material; your teacher will inform you on how many cups to make and the contents of those cups. Possible contents of the cups are as follows:
   - Gravels (aquarium gravel works)
   - Coarse sand (playground sandbox sand)
   - Fine sand (garden sand)
   - Clay (if available, possibly from soils around your home or from a stream bank)
   - Mixture of Gravel and Sands
   - Mixture of Coarse and Fine Sands

3. Using a beaker, measure out the same volume of the **DRY** soil material for each cup. Record this volume.

   _____ mL of soil material in each cup

4. Fill out the first 2 columns in the chart below. You will predict which soil material will have the highest porosity and rank them from highest porosity (1) to lowest porosity.

Contents of cup – all with same volume of material	Predicted rank for highest porosity (have 1 = highest)	Volume of water soil material holds (pore space) (mL)	% porosity	Rank of porosity for cups (have 1=highest)

5. Fill a small volume graduated cylinder with water, noting the initial amount of water in the cylinder. You need to keep track of how much water will use in the next step.

6. For this step, your goal is to pour just enough water into the cup's soil material to fill all of the pore spaces in between the soil particles, but you do not want to overfill the container. Pour water from the graduated cylinder into the cup of soil material. Keep pouring water in as long as the soil absorbs it. As soon as any water starts to puddle or remain on top of the soil material, do not add any more water. In fact, if water remains on the surface and does not get absorbed, use an eyedropper to carefully suck off the surface water and *place it back into the graduated cylinder*.

7. Based on the water remaining in your graduated cylinder, determine how much water you used to fill the pore spaces in the cup's soil material. This is the volume of pore space. Record this value in the data table.

8. Now determine and record the % porosity using the formula below for each other sediment cups in the chart.

$$\% \text{ porosity} = \frac{\text{Volume of pore space}}{\text{Total volume of sediment}} \times 100$$

9. Repeat steps 5-8 for any additional cups of material.

10. Once the data table is complete, review your predicted rankings. Did you correctly predict which sediment type had the highest porosity? Why were you correct or why were you wrong?

11. If you were to dump out only the water from your cup, keeping the sediments, and then try this experiment again, why would your porosity likely decrease for this second trial?

12. Please listen to your teacher for cleanup procedures or to find out about your next experiment.

Name: _____ Class: _____

Student Worksheet: *Porosity and Permeability* - *Experiment #2*

Experiment #2 - Determining Permeability of Soil Materials

1. Define permeability.

2. If not done already, obtain clear plastic cups or empty pop containers with holes in the bottom. If no holes, poke numerous holes in the bottom of each using a thumbtack or metal dissecting probe. Keep the approximate number of holes equal between all cups. You will be filling cups with various types of soil material (possibly the soil material used in *Experiment #1 – Determining Porosity of Soil Material)*; your teacher will inform you on how many cups to make and the contents of those cups. Possible contents of the cups are as follows:
   - Gravel (aquarium gravel works)
   - Coarse sand (playground sandbox sand)
   - Fine sand (garden sand)
   - Clay (if available, possibly from soils around your home or from a stream bank)
   - Mixture of Gravel and Sands
   - Mixture of Coarse and Fine Sands

3. Fill cups with the same volume of the various types and sizes of sediments. They do not have to be dry.

4. Fill out the first 2 columns of the chart below.

Contents of cup – all with same volume	Predicted rank for permeability (drainage) of cup (have 1=fastest)	Amount of time for water to drain through soil (min)	Actual rank of permeability (drainage) of cups (1=fastest)

5. Pour equal amounts of water (your teacher will determine this amount) into each cup and allow them to drain over an empty catch container/beaker. Keep track of how long it takes for all of the water to drain through the sediments – this should be the point when water stops dripping from the bottom of the cup. Record this time in the data table.

6. Repeat this procedure for any of the other cups of material. Fill in data table accordingly.

7. Once all cups have been tested. Rank the cups with highest permeability (quickest to drain) to least permeability (slowest to drain). Did you correctly predict which cup had the highest permeability? Why were you correct or why were you wrong?

8. Did the soil materials with higher porosity also tend to have higher permeability? Were there any exceptions to this correlation?

9. Why are both porosity and permeability of the soil/rock layers important factors to consider if you wanted to drill a groundwater well to obtain drinking water for your home?

10. Based on your experimentation, what type/s/ of soil/rock material would you want to drill into to obtain a sufficient groundwater supply? Why?

11. If you had two cups for the permeability experiment, each with the same amount of the same type of sand, but one cup's sand was wet and the other cup's sand was dry, which cup would drain quicker? Why?

12. Please listen to your teacher to determine clean up procedures.