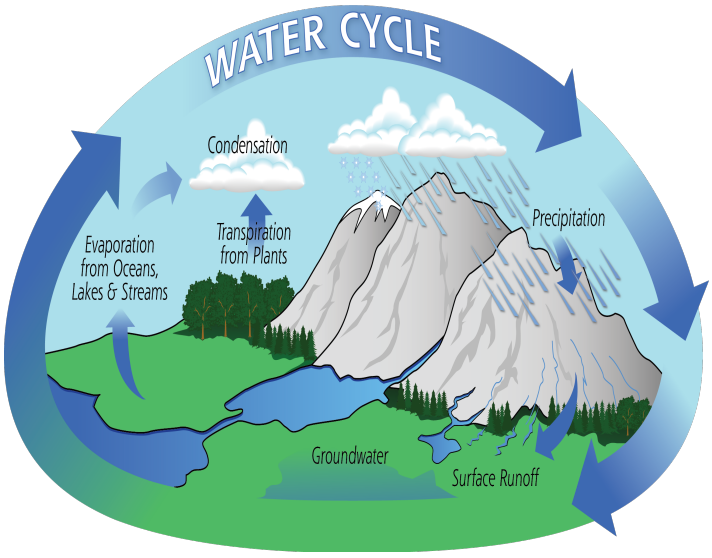
MEGA MOLECULES

If I am a hydrogeologist…
I study how water moves through rock layers below the surface of the Earth.

Experiment 5
Rock Pockets

You will need the stirrer (B), 2 beakers (H), measuring cup (K), 2 foam cups (L), sand and gravel rock (O), washable marker, water, paper towels, and a phone with a stopwatch.

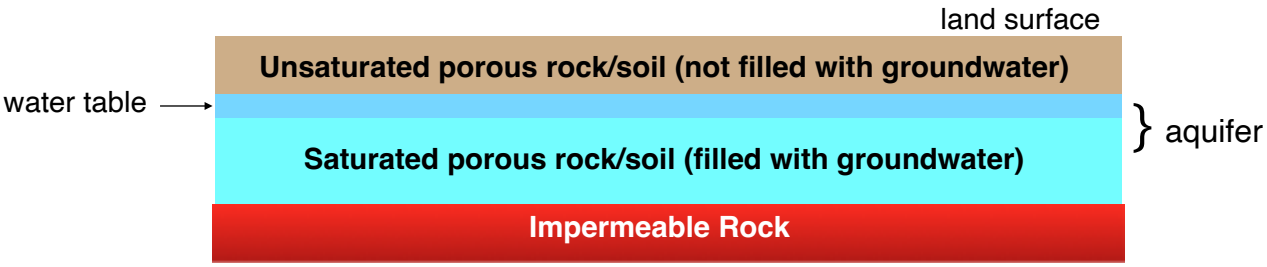
Things To Know:



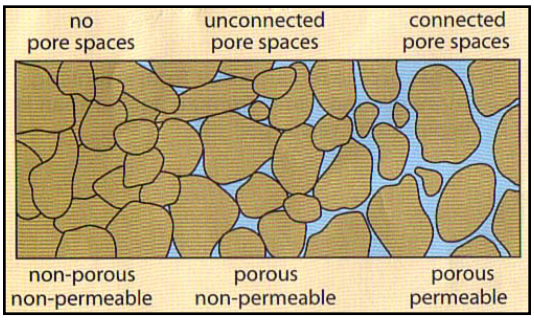
The water cycle, also known as the hydrologic cycle describes the continuous movement of water on, above, and below the surface of the Earth. When it rains, some of the water may flow across the ground and collect in oceans, rivers or lakes. This water is called surface run-off. Other precipitation may soak into the soil and move through the land as groundwater. Eventually, the water may evaporate or transpire from plants and the water cycle begins again.

The groundwater is an important natural resource. It is used in business and industry, for irrigation in agriculture, and for drinking water in rural areas. When groundwater completely fills an underground area of porous rock, it is called an aquifer. The water

table is the upper layer of the aquifer. The groundwater from the aquifer can be brought to the surface by drilling a water well.



There are two characteristics of rocks and two forces that control the flow of water downward through the ground. The two characteristics are porosity and permeability. Even though rocks seem to be solid, there are many cracks and tiny pores inside them. Some types of rocks contain more pores than other rocks. They are said to have greater porosity. Rocks with connected pore spaces are permeable and water can flow between the pores. Permeability is a measure of the ease with which water can flow through a porous rock.



The opposing forces that control the movement of water downward through the ground are gravity and molecular attraction. Gravity is a force by which all objects with mass are brought toward one another. In this experiment, the force of gravity causes water to flow down through the rocks. The second force, molecular attraction, slows the flow of water through small pores. Water molecules are attracted to the surface of rocks. This molecular attraction is called adhesion. The two forces along with the porosity and permeability of the rocks determines the flow of water through the ground.

What To Do:

1. Answer questions #1-3 on the student sheet.
2. Use the stirrer to poke three holes in the bottom of each of 2 foam cups. Remove the "cut-outs" from the holes.
3. Make 2 filter papers by placing a paper towel under the foam cups and tracing around the bottom of the cups. Cut the paper towel along your tracing lines.
4. Put a filter paper in the bottom of each foam cup.
5. Add 30 cubic centimeters (1 cubic centimeter = 1 mL) of gravel rock to the measuring cup. Pour the rock into one of the foam cups.
6. Place the foam cup and rock into the beaker as shown below. Put the stirrer between the foam cup and the beaker.

7. Wet the rock by adding 10 mL of water to the measuring cup. Pour the water over the rock. When the water has drained from the rock, take the foam cup out of the beaker and set it on a paper towel. Pour the water out of the beaker.
8. Repeat steps 5-7 using the second foam cup and 30 cubic centimeters of sand.
9. Rinse and dry the measuring cup and beaker.
10. Place the foam cup (with sand) into the beaker again as shown above. Use the washable marker to mark the 40 mL line of the beaker.

11. Fill the measuring cup with 60 mL of water. START TIMING when the water is poured into the foam cup.
12. STOP TIMING when the water level reaches the mark at the 40 mL line on the beaker. Record the time in seconds in the table on the student sheet.
13. Repeat steps 9-12 for the second trial.
14. Repeat steps 9-13 using the foam cup (with rock).
15. Calculate the average for the two trials for the sand permeability test by adding the times for the two trials and dividing by 2. Record the average time in seconds in the table on the student sheet.
16. Repeat step 15 to calculate the average for the two trials for the rock permeability.
17. Make a bar graph on the student sheet to compare the time required for the water to move through the sand and rock.. The average time in seconds is on the vertical (y) axis. Make each box on the vertical axis the same number of seconds. Clearly label the times on the vertical axis. A shorter time for the water to move through the material indicates a greater permeability.
18. Answer the questions on the student sheet.

MEGA MOLECULES

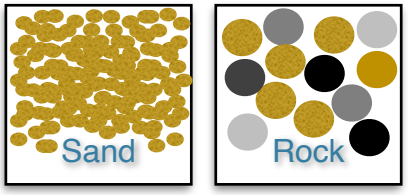
Name _____ Date _____

Experiment 5: Rock Pockets

1. What is porosity?

2. What is the difference between porosity and permeability?

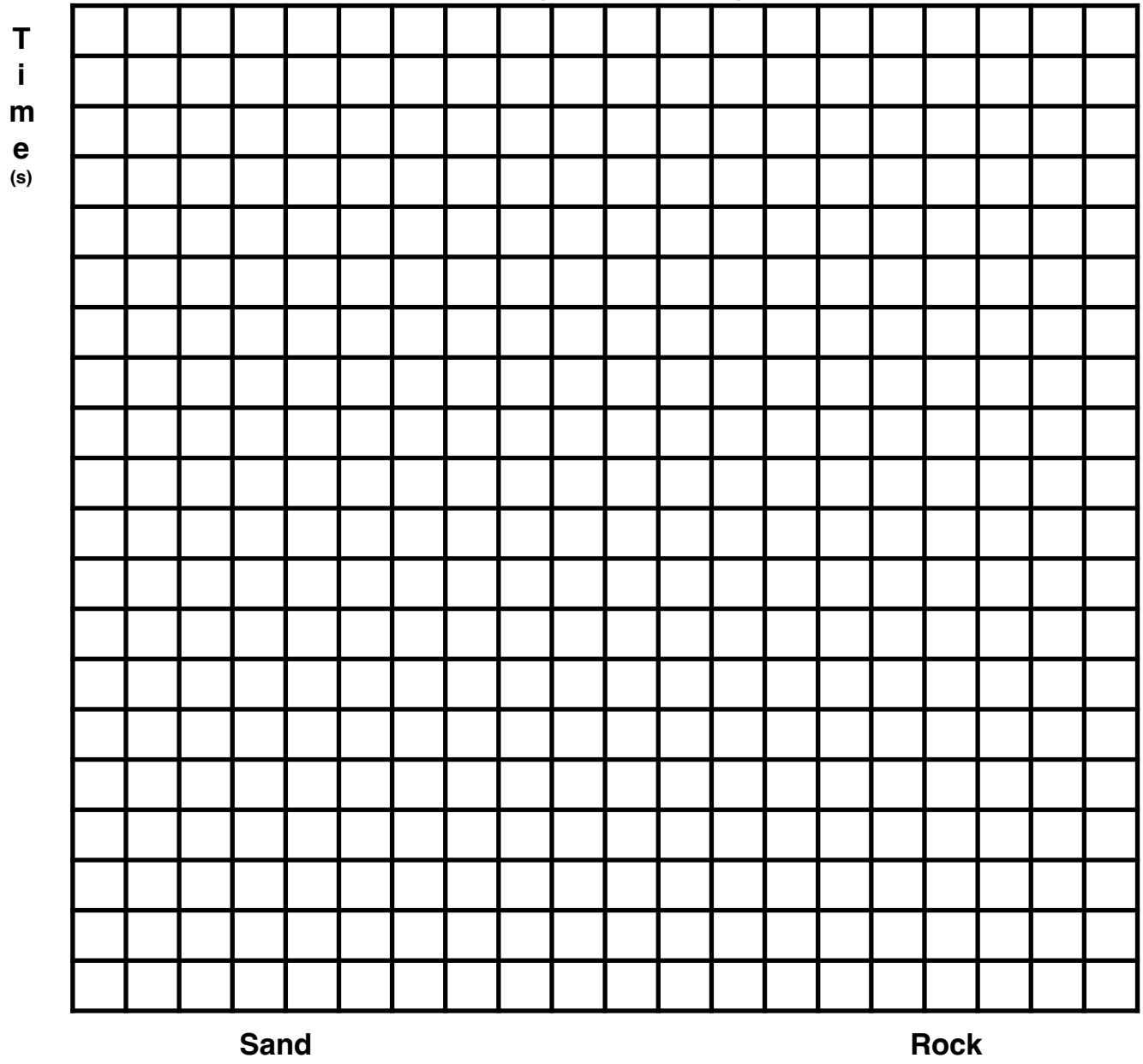
3. Predict which of the formations (sand or rock) is more porous and has a greater permeability. Explain your reasoning.



Data Table

Time For The Movement Of Water Through The Formations			
Type Of Formation	Trial 1 Time (s)	Trial 2 Time (s)	Average Time (s)
Sand			
Rock			

Bar Graph of Average Time vs. Type of Formation



4. Which formation, sand or rock, does the water go through fastest?

5. Which formation, sand or rock, is the most porous and has a greater permeability?

6. Provide evidence that objects exert forces on each other.

7. Explain how the forces were responsible for the results of this experiment.

8. Discuss sources of error in the experimental design.

9. Suggest one way to improve the experimental design.