Name: _____ Date: _____

Student Exploration: Porosity

Vocabulary: aquifer, gravel, permeability, porosity, sand, saturated, sediment, silt, standing water

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
Two students are given cubic boxes, measuring 10 cm on a side. Robert puts a single glass marble with a diameter of 10 cm in the box. Susan puts 1,000 1-cm glass marbles in her box.

1. Whose box has more empty space? Explain. _____

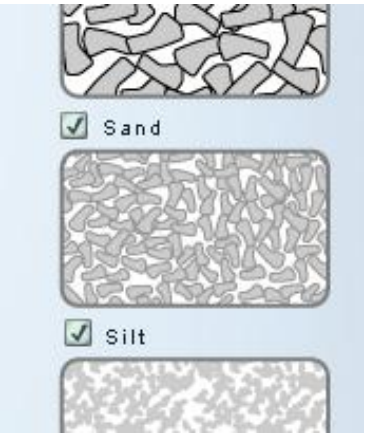
   _____

   _____

2. Whose box will be heavier? Explain. _____

   _____

Gizmo Warm-up
Some rocks and **sediments** have a lot of empty space in them. This allows liquids such as water and oil to pass through and be stored in them. **Permeability** describes how easily liquid passes through a material, while **porosity** describes how much liquid can be stored in the material. These properties are explored in the *Porosity* Gizmo™.



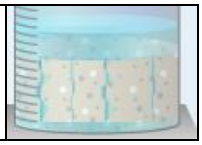
Turn on the **Macroscopic view** of **Gravel**, **Sand**, and **Silt**. **Gravel** consists mostly of rock fragments greater than 2.0 mm in diameter. **Sand** consists of grains that are between 0.0625 and 2.0 mm in diameter. **Silt** consists of grains that are between 0.0039 and 0.0625 mm in diameter.

1. Which sediment do you think will allow water to pass through most easily? _____

2. Which sediment do you think could hold the most water? _____

3. An **aquifer** is a rock layer that stores and allows the flow of groundwater. Compared to other types of rock layers, how permeable and porous would an aquifer be?

   _____

Activity A: **Permeability**	Get the Gizmo ready: • If necessary, click **Reset** below each container of sediment.	

Question: How does permeability relate to the grain size of sediment?

1. Observe: Above the gravel container, click **ON**. Observe water moving through the gravel.

   A. Does the water pass easily through the gravel? _____

   B. Repeat the same procedure with the sand and silt. What do you notice?

   _____

   _____

2. Gather data: Water that pools above the sediment is called **standing water**. Standing water can be an indication that sediments are **saturated** (full of water) or not very permeable.

   Click **Reset** below each container. Release about 100 mL of water into the gravel beaker, and press **OFF**. Record the approximate amount of standing water you see just after you press **OFF**. Repeat the same procedure for the sand and silt.

   Gravel: _____ Sand: _____ Silt: _____

3. Analyze: Based on your data, which is the most permeable sediment? _____

4. Infer: How do you know the standing water is not there because the sediment is saturated?

   _____

   _____

5. Draw conclusions: How is permeability related to the size of the grains that make up the sediment? _____

   _____

6. Apply: Suppose you were digging a well into saturated sediments. Why is the sediment's permeability an important factor in deciding where to put your well?

   _____

   _____

Activity B: **Porosity**	Get the Gizmo ready: • Click **Reset** below each container of sediment.	

Question: How does porosity relate to the grain size of sediment?

1. Predict: Which sediment do you think has can store the most water? _____

   Explain your choice: _____

   _____

2. Gather data: Release 400 mL of water into each sediment. Wait until each sediment is fully saturated with water. Record the amount of standing water in the first row of the table below.

Sediment:	Gravel	Sand	Silt
Standing water (in mL):			
Water in sediment (in mL):			
Sediment volume (in mL):	400 mL	400 mL	400 mL
Porosity (%):			

3. Calculate: Find the amount of water that is stored within each sediment by subtracting the standing water volume from the original water volume (400 mL). Add this data to the table.

4. Calculate: To calculate the porosity percentage, divide the volume of water in the sediment by the sediment volume, and then multiply by 100. Add this data to the last row of the table.

5. Analyze: Which is the most porous sediment? _____ The least? _____

6. Draw conclusions: Compare the porosity number to the grain size of each sediment.

   A. Does grain size determine the porosity of a sediment type? _____

      Explain: _____

      _____

   B. Explain what you think controls a material's porosity. _____

      _____

      _____