THE WATER RACE: PERMEABILITY AND POROSITY

Objectives:

Students will

- define permeability and porosity,
- predict and test permeability of different rock types,
- relate makeup of rock layers and use of the area to permeability.

Materials:

- 2 (20 oz) plastic soda bottles one filled with gravel, one filled with sand (rock bottles)
- 2 (20-oz) plastic soda bottles filled with water
- pieces of sandstone and limestone
- geology cards



Water moves in a continuous cycle between the air, ground, plants, and animals. The roots of a plant might use the water that soaks into the earth. But if no plant captures the water, it might travel downward through the rocks and soil. The movement is called infiltration. The rate that water travels through the rock depends on the permeability of the rock layers. The spaces, or pores, in the rock allow the water to travel through it. If we magnify rocks such as limestone or sandstone many times, we would see that they are full of tiny holes. These spaces have an enormous ability to carry and hold water. The measure of space available to hold water is called porosity. Igneous rocks, like granite, have formed in such a manner that the minerals are very close together and water can not easily get into it. Sandstone is very porous; the water will be easily soaked up within the spaces or pores of the rock.

How easily the water travels through the rock is called the permeability. In rocks, permeability depends on the size of the pores and on how connected they are to one another. Rocks, such as limestone are porous but they also crack very easily allowing the water to travel through. Rocks often associated with caves are limestone, sandstone and shale or clay. Shale or clay is impermeable; the water will not travel easily through the rock.

How the water travels through the rock determines how much water gets into the ground. The availability of groundwater varies in different areas of the world and is determined by the permeability or porosity of the type of rock in that area. We will be investigating groundwater in limestone and sandstone. Bedrock can also filter water as it seeps into the ground encountering the different rock types.

Procedure:

- 1. Have the students investigate the piece of sandstone. How does it feel? Is it gritty or sandy? Slowly pour water on it. What happens to the water? Why? Show the students the cards and ask them which illustration represents sandstone. Have them recall how sandstone forms.
- 2. Have the students investigate the limestone. How does it feel? Have them slowly pour water on the limestone. What happened to the water? Why? Since most caves form in limestone, ask them to predict how the water could get into the rock level. Show the



- students the cards and ask them which illustration represents limestone. Have them recall how limestone forms.
- 3. Have the students investigate a piece of clay. How does it feel? Does it feel like either of the other rocks? Have them pour water on the clay. What happened to the water? Why? Show them the cards and ask them which illustration represents clay. How does shale or clay form?
- 4. Show students the bottle of sand and the bottle of gravel. Ask them to determine which type of rock each bottle represents limestone or sandstone. Ask the student to predict which type of rock they think the water will travel through the fastest.
- 5. Ask for 4 volunteers to perform the water race. The volunteers will form pairs, one pair with the sandstone, one with the limestone. One person will hold the rock bottle; the other person will slowly pour water into the rock bottle. The other team will be arranged the same.
- 6. When every one is ready have the students with the water bottles pour water into the rock bottles without spilling any water. When one group "wins" the race by filling the rock bottle and all the spaces possible with water, have the other group stop. Discuss why the group won. What does that say about the permeability of the rock? How will the permeability of the rock affect the quality of the water entering into groundwater.

7. Discussion questions:

- Can bedrock affect the amount or rate of contamination to the groundwater?
- Would sandstone or limestone allow more contaminants?
- Which one would allow the contaminants to get there faster?
- Could this have an effect on a cave?
- What if there were a parking lot or houses over the cave?

