How Does Water Move Through the Earth?

(adapted from Earth: the Water Planet)

Goal: To demonstrate the presence and character of pore spaces in sediments and rocks.

Indiana Proficiencies and Competencies:
Middle/Junior High School 1.1, 1.2, 1.5, 2.1, 2.2, 3.2, and 9.2; First year Earth and Space Science 1.1, 1.5, 2.2, 7.2, and 9.3; Environmental Science, Advanced 1.1, 1.4, 1.5, 2.1, 2.2, 5.1, 6.1, and 7.1.

Materials needed:
- 7 small transparent containers - clear plastic 5 oz. cups are ideal.
- marbles or pebbles
- fine, dry sand, enough to fill three of the cups
- water
- an eyedropper

Overview: We are all dependent on a safe source of water to survive. Approximately 72% of all Hoosiers rely on ground water as a source of drinking water. The remaining 28% depend on surface water. No matter what the source of water you use for drinking, be it ground water or surface water, there are certain things that can be done to protect the water from damaging contamination.

Procedure:
1. Mark each container with a line at the same height, just below the top and label one "sand" and one "pebbles".
2. Fill two of the unlabeled cups (to the line) with pebbles (or marbles).
3. Fill two other of the unlabeled cups (to the line) with sand.
4. Fill three (to the line) with water, one of the water cups will be used with the sand - the one labeled "sand" - and one with the pebbles - the one labeled "pebbles."

   What is in each cup? Which cup, the sand-filled or the pebble (or marble) filled has the most pore space?

Test Your Hypothesis:
5. Pour one of your of water cups (the one labeled "sand") very slowly into one of the "full" cups of sand, until the water is just up to the fill line. Reserve the remaining water in its original cup. If you happen to pour too much, use the eyedropper to replace the water into the water cup. The water that you used to fill the sand-filled cup filled the pore spaces between the grains of sand. Estimate (or measure) how much was removed from the water cup to fill the sand cup. Set these two cups aside.

6. Now pour water from the second water cup (the one labeled in its original cup. If you happen to pour too much, use the eyedropper to replace the water into the water cup. The water that you used to fill the pebble-filled cup filled the pore spaces between the pebbles. Estimate (or measure) how much was removed from the water cup to fill the pebble cup.
7. Compare the amount of water needed to fill the pores between the pebbles with the amount of water needed to fill the pores between the sand grains. Record your observations, and set all the cups aside for later.

For more discussion:

- *Since ground water flows through the pore spaces in soils or rocks, what type of materials could contain the most ground water? What characteristics would allow for the ground water to flow fastest?*
- *Describe how ground water moves through the soil. How will the size and shape of the pore space effect the rate of flow of ground water? What implications does this have on the transport of contaminants? Would you rather spill something into sand or clay-like soils?*
- *Now consider the last cup of pebbles. If you were to fill the pore space with sand, how would this affect the volume of water that could be added? Make a guess (form a hypothesis) and test it by continuing with step 8.*

8. Gently pour the remaining cup of sand into the cup of pebbles (up to the fill line), tapping to make the sand settle between the pebbles. Then add water from the final cup of water, again filling up to the fill line. How much water could the mixed sand and pebbles hold? Compare the results of this experiment with the previous two. Record your observations.