Marbles in a Jar

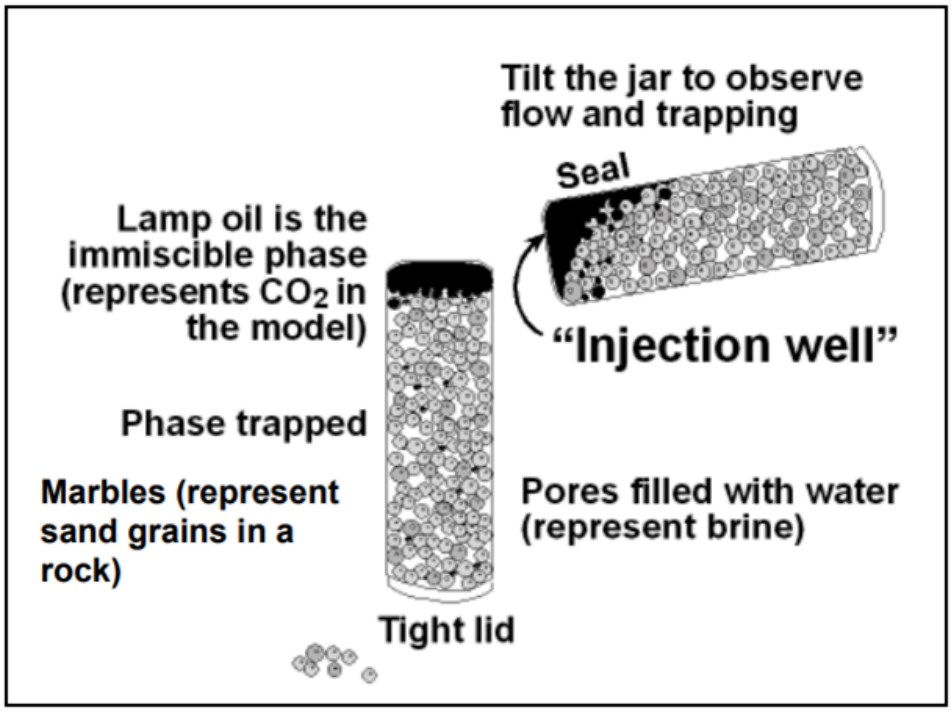
How do fluids like CO_2 flow when injected into sandstone?

Scientists and engineers have determined that one of the options to mitigating CO_2 release into the atmosphere is to capture it and store or "sequester" it underground. What exactly does that mean? Some students have misconceptions about reservoir rocks and imagine a big cave, which seems like it might collapse or blow out if you fill it with CO_2. This model lets them see how CO_2 could be stored underground in pores in the rock and how it is trapped by reservoir seals and phase trapping.

Objectives

This learning activity is designed to demonstrate:

1. Storage of fluids underground in reservoir rocks
2. Concepts of porosity and permeability
3. Trapping mechanisms for CO_2 underground in reservoirs



Materials Needed:

- Glass Jar
- Marbles: Magnified Sand grains
- Red Lamp Oil: CO_2 stored
- Water: Existing reservoir water

Procedures for Guided Inquiry Activity:

- The jar shows you what you would see if you had a microscopic view of a CO_2 storage site underground. The marbles are sand grains, and the water is salt water that fills the spaces.

- Have students tip the jar from vertical to near horizontal and watch the "CO_2" move through the holes in between the marbles. CO_2 floats on top of water, so it tries to move upward. It is held underground by seals on the injection zone, just like this "CO_2" is held in by the sides and walls of the jar.

- The small pores are the "micro-caves" that would store the CO_2 underground. CO_2 is also prevented from escape because it is trapped as small bubbles snap off from the main body. This is a persistent characteristic of two-phase behavior, and it may be important in ensuring that CO_2 stays underground. Try jostling the bottle. It is pretty hard to get those phase-trapped bubbles to move!

Thinking Questions

- The lamp oil travels upward no matter which way you move the jar. What scientific force is driving that movement?
- Why are the two fluids not mixing in with each other?