Science Lesson - Elementary level

Porosity and Naturally Occurring Oil and Gas Seeps

Materials Needed:

One medium Jar (with lid) per student pair
Marbles or small rocks to fill ¾ of each jar
Enough water to cover the marbles in each jar
Food coloring (optional)
One quart of vegetable oil

Anticipatory Set:

Did you know that California has some of the most active oil and gas seeps in the world? According to studies released by the California State Lands Commission, more than 1,200 natural seeps have been charted in the Santa Barbara Channel alone! Geoscientists with the U.S. Minerals Management Service, the government agency responsible for managing the nation's offshore mineral resources, estimates that on any given day the equivalent of 100-150 barrels (forty-two gallons in a barrel) of oil flows naturally into the Channel's marine environment! The oil flows naturally from seafloor and coastal seeps found in and along California's Santa Barbara Channel.

Have you ever gone to the beach and stepped into what appears to be thick black slime? Well, often this black stuff is actually thick gooey oil that has found it's way to the earth's surface through natural seeps.

Objective:

The students will know how oil and gas flows through the crust of the Earth. They will also learn about the concept of porosity, and it's effect on the flow of oil and gas.

Input:

Rocks are made up of small grains that are squeezed and cemented together. The space between the grains is called **pore space**. The rock's **porosity** is determined by the amount of space found between each grain. If the rock has a considerable amount of space between each grain it is **porous**, like sandstone. These types of rock easily allow oil and gas to flow through the pore space toward the rock's surface. Rocks made up of very tiny grains are **less porous** because they have very little space between each grain. Oil and gas may not be able to flow through these types of rock.

Since oil and gas are lighter than water, they float on the water toward the rock's surface. Rocks that are **less porous**, like shale, prevent oil and gas from flowing to the surface. Oil and gas may flow to the surface through breaks (fissures and faults) in the **sedimentary layers** of rock. When oil and gas successfully flows through the various layers of rock to the Earth's surface, either on land or on the seafloor, it is called a **natural seep.**

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Modeling:

Explain to the students that we are going to conduct an experiment to see how porosity affect oil and gas seeps on the surface of our planet.

Explain to the students what the different materials of our experiment are going to represent. The jar represents the rock beneath the Earth's crust, the marbles will represent the grains that form the rock deep within the earth's crust, the space in between the marbles represents the space (pores) between the rock grains, the vegetable represents the oil trapped beneath the earth, and the water represents itself.

Take a jar and fill it with like-size marbles or small pebbles. Add vegetable oil until the jar is 1/3 full. Then add water until the jar is almost full (leave a little space for air). Set aside the jar for later observation.

Explain to the students that the pores in the Earth's crust are never empty. Deep below the Earth's surface this space is filled with water, oil or gas. Tip the jar (your sandstone rock) upside down and prompt the following questions:

1. **What do you notice about the oil and gas in the sandstone rock?**
2. **Does the oil and gas move easily through the rock? Why do you think this occurs?**
3. **How do you think the porosity of the rock affects the flow of the oil?**
4. **Does the oil and gas continue to move toward the surface? Why do you think this occurs?**

Check for understanding:

Ask questions such as:

1. **What is the space between rock grains called?**
2. **What is porosity?**
3. **What determines a rock's porosity?**
4. **Why is it that oil can flow more easily to the surface through very porous rocks than through less porous rocks?**
5. **What is a natural seep?**

Guided practice:

Review with the students the procedure you took in creating your own model of the rock grains and oil flow. Ask students to quietly tell you aloud the steps you took. Write these steps on the board for the students to use if they forget the steps involved in creating their own model.

Once you are done pass out needed materials to the student pairs. They can begin building their own model. Walk around to the different pairs of students assessing their comprehension and grasp of the concept.

Independent practice:

For independent practice the students will create an illustration (geologic cross section) of the process involved when oil and gas seeps to the surface. Their illustration should also include a flow chart that outlines the oil's rise to the surface of the Earth.

Lesson Developed by: Mr. Fortunato Lopez, Ramona Elementary School, Oxnard, CA
Contributors: Mr. James Galloway, MMS Pacific Region geologist