# RESERVOIR IN A JAR MODEL

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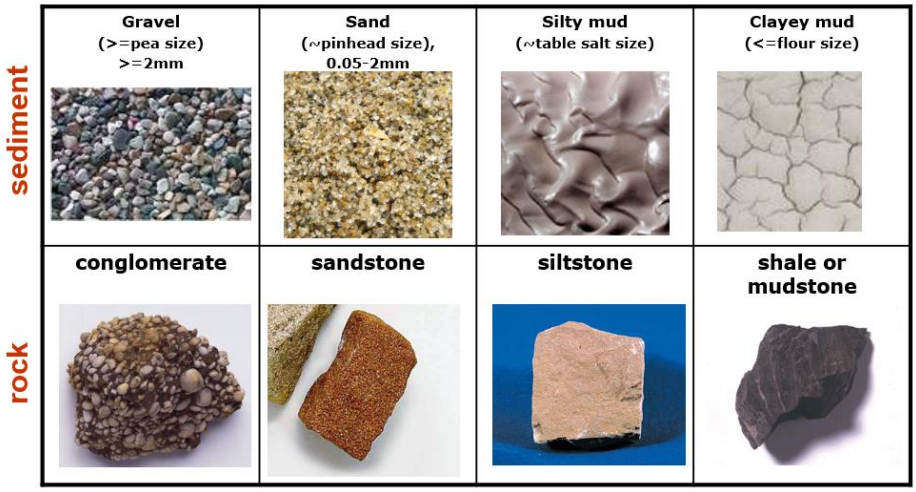
## Introduction and Background Information

The *Reservoir in a Jar* model was created by Dr. Prodanović to serve as a visualization of petroleum aka oil and natural gas being stored in the pore space of rock AND demonstrate how petroleum and natural gas migrate through the pore space of a geologic formation.

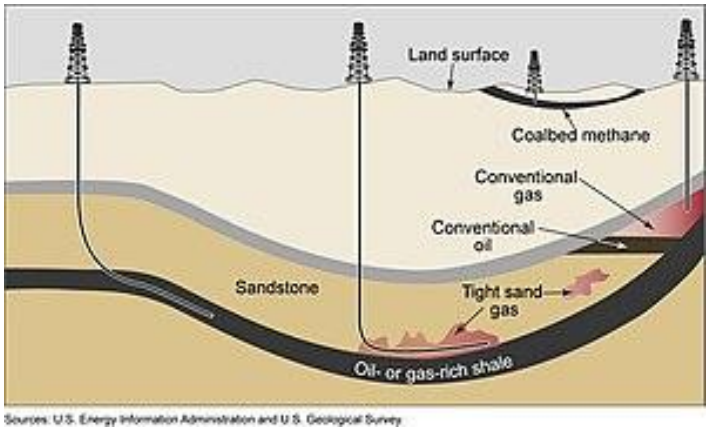
The quantity of petroleum and natural gas stored in the pore space is dependent of the *porosity* of the formation. Porosity is the percentage of empty space in a rock where fluids can be held. Porosity of rocks vary based on the composition of that rock. Sedimentary rocks are formed from *sediments* – pieces of other rocks, minerals, or organic matter that are compacted over time. Since some sedimentary rocks can be formed with particles of organic material, these geologic formations can be sources of petroleum and natural gas.

***Different size sediments and their corresponding rock.***




To understand how petroleum and natural gas move in sedimentary geologic formations, scientists study the properties of rocks, including rock porosity. This data can be valuable when determining how to remove the petroleum and natural gas from the ground. If petroleum and natural gas have migrated to traps in the geologic subsurface, conventional wells can be used to extract these resources from the subsurface. However, if petroleum and natural gas are stored in the pore space of a sedimentary geologic formation, an unconventional well is used to reach these resources in the pore space. The most common approach is this use of hydraulic fracturing.

The Reservoir in a Jar is an easy way for students to see a fluid trapped in the pore space of a geologic formation and by manipulating the jar (turning it upside down), students can see how that colored fluid moves through the pore space. When the jar is left undisturbed for a period of time, the less dense colored fluid will accumulate at the top of the jar. This demonstrates how hydrocarbons accumulate in traps in the subsurface.




Source: https://commons.wikimedia.org/wiki/File:Figure_1-_Conventional_and_Unconventional_Oil_and_Gas_Reservoirs_(8080671862).jpg

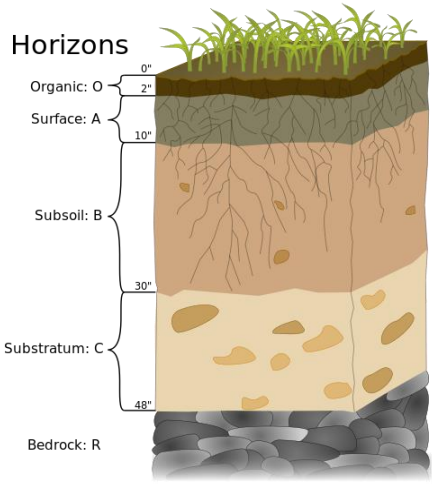
**USING OF THE MODEL**

This model can be used as a **Phenomenon Engage Activity** to introduce the concepts of porosity and permeability. To learn more about phenomenon-based-learning, you can read more here – The Wonder of Science.

**The model can be out on student desks as they arrive to class and you can encourage students to manipulate and observe the fluid in the jar. Have students write down their individual observations and/or have students collaborate to discuss what they observe and create explanations for what they see happen to the fluid in the jar.**

The purpose of this model and phenomenon activity is to help students understand porosity of rock and soil, movement of fluids in the soil pore space, and connect to studying how oil and natural gas migrate through the pore space of rock formations.

- When teaching soil properties, students will learn how the composition of soil is dependent on the ratio of sand, silt, and clay present. How well water moves through the soil is dependent on this ratio of particles. The jar can be used to discuss with students how the particle size influences how fast or slow water moves through soil.
    - The ratio of sediments in soil is related to the existing rock that is weathered. That existing rock is determined by the geologic history of the area. If the ancient environment was an ocean floor, like Texas during the Cretaceous, a limestone is commonly formed. Weathered limestone can lead to a higher concentration of clay sediments in the soil profile.
    - If jars are made with different size hydrogel beads, students can see how the red fluid moves differently in the pore space.

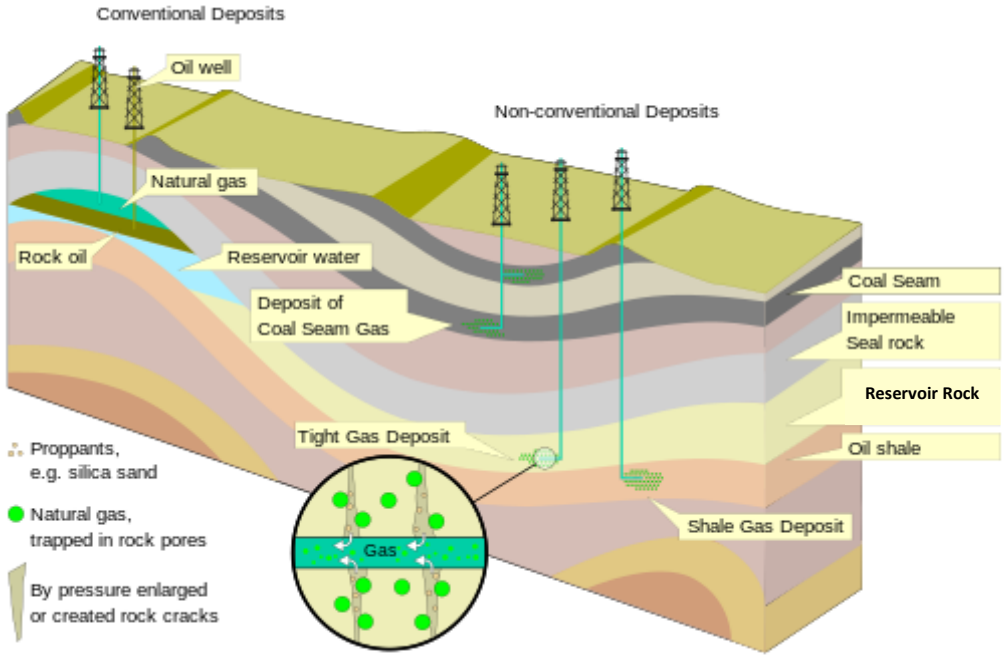



Source: https://commons.wikimedia.org/wiki/File:Soil_Horizons.svg

    - More models can be created with sand, silt, and clay particles to accompany the jar model. If you are not able to obtain sand, silt, and clay, other materials can be used to serve as a model for the 3 different sizes. Different size beads can be used to represent the 3 particles. Students can look at the relative size of these particles and observe their differences in porosity.

- Learning about how oil and natural gas are trapped or stored in the subsurface is influenced by the pore space of the rock layers. Oil and natural gas move through the pore space and can accumulate in areas where there is an impermeable rock layer preventing further migration. This can form an oil trap. The jar can show students how oil and natural gas move through pore space and if jars are made with different size hydrogel beads, they can visualize how the oil and natural gas move through the different size pore spaces.

- Oil and natural gas can be stored in the pore space of sedimentary rocks. They have not migrated upward and have not accumulated in a trap. These are situations where unconventional wells are used to access the oil and natural gas.
    - To best understand the quantity of oil and natural gas that are stored in the pore space, scientists must understand the relative porosity of sedimentary rocks. This information also helps planning an unconventional well that will be used to produce the oil and natural gas. Models like this jar can help scientists visualize the movement of less dense material move through the pore space of rocks.




Source: https://commons.wikimedia.org/wiki/File:(Non)_Conventional_Deposits.svg

## CONSTRUCTING THE MODEL

Follow the directions below to construct your models.

Photo Credit: Sabrina Ewald

**Materials:**

| | | |
|---|---|---|
| Glass Jars | Mineral Oil (Baby Oil) | Water |
| Hydrogel Beads | Coloring (oil-based) | |


*An alternative to glass jars can be tall **glass** vials with secure lids. Can be easily purchased on Amazon.

Follow the same directions to create the model using this container.

**Building the Reservoir:**

1. The hydrogel beads will need to be hydrated. Hydrogel beads can be purchased on Amazon. There are different sizes and any size can be used. Note that different sizes will yield differences in the pore space. Be sure to follow the directions to properly hydrate the beads to their maximum size.

2. Add the oil-based coloring to the mineral oil BEFORE adding to the jar. You can find powder-based food coloring that can be used or use candle wax dye.

3. Once the hydrogel beads are hydrated, add beads to the jar. Fill to the top of the jar, but do not over-fill. You want to be able to easily tighten the lid and account for space for the water.

4. Next, add water to the jar, filling almost to the top. Leave some space in order to be able to add the mineral oil. Be sure to adjust your water level before adding the colored mineral oil.

5. Finally add a small amount of colored mineral oil to the jar. Roughly about 25-30 mL of mineral oil. You can judge quantity based on the amount of space you have at the top of your jar. Again, you want to be sure you can close the jar with the lid and tighten it as much as possible.