

 **Activity 7.3.3 Enhanced Oil Recovery****Purpose**

You may have seen images of oil spurting from the ground or being pumped from wells. Together, these methods extract only about 15% of the oil in the ground. Enhanced oil recovery (EOR) methods can be employed to remove approximately 40% of the oil in the ground.

One method of EOR is geologic sequestration, which sequesters or traps unwanted products while extracting desirable products. One example is carbon dioxide sequestration. Carbon dioxide is pumped into the oil reservoir increasing the pressure making it easier to extract the oil. The carbon dioxide, often considered an unwanted greenhouse gas, is then trapped and stored in the reservoir.

Hydraulic fracturing, or fracking, is another method for increasing oil and natural gas production. Hydraulic fracturing injects water and gas under high pressure, opening channels in deep shale formations to release natural gas deposits. Sand, walnut shells, ceramic particles, or other agents are pumped into the channels and used to facilitate the extraction of gas. Fracking is controversial due to the large volumes of water required, waste water produced, and the potential for groundwater contamination.

In this activity, you will use a working model to simulate the process of enhanced oil recovery. Does the model demonstrate the risk and benefits of the EOR process? Does the EOR process raise concerns about environmental impacts as you consider the chemicals used?

Materials**Per group of four students:**

- 2 250ml Erlenmeyer flasks
- 250ml beaker
- 100ml beaker
- 2 double hole stoppers
- 3 3" pieces of rigid plastic tubing
- 6" piece of rigid plastic tubing
- 2 15" pieces of flexible plastic tubing
- Soap solution
- 30ml syringe
- 200ml simulated oil
- Weigh boat
- Baking soda
- Vinegar

Per student:

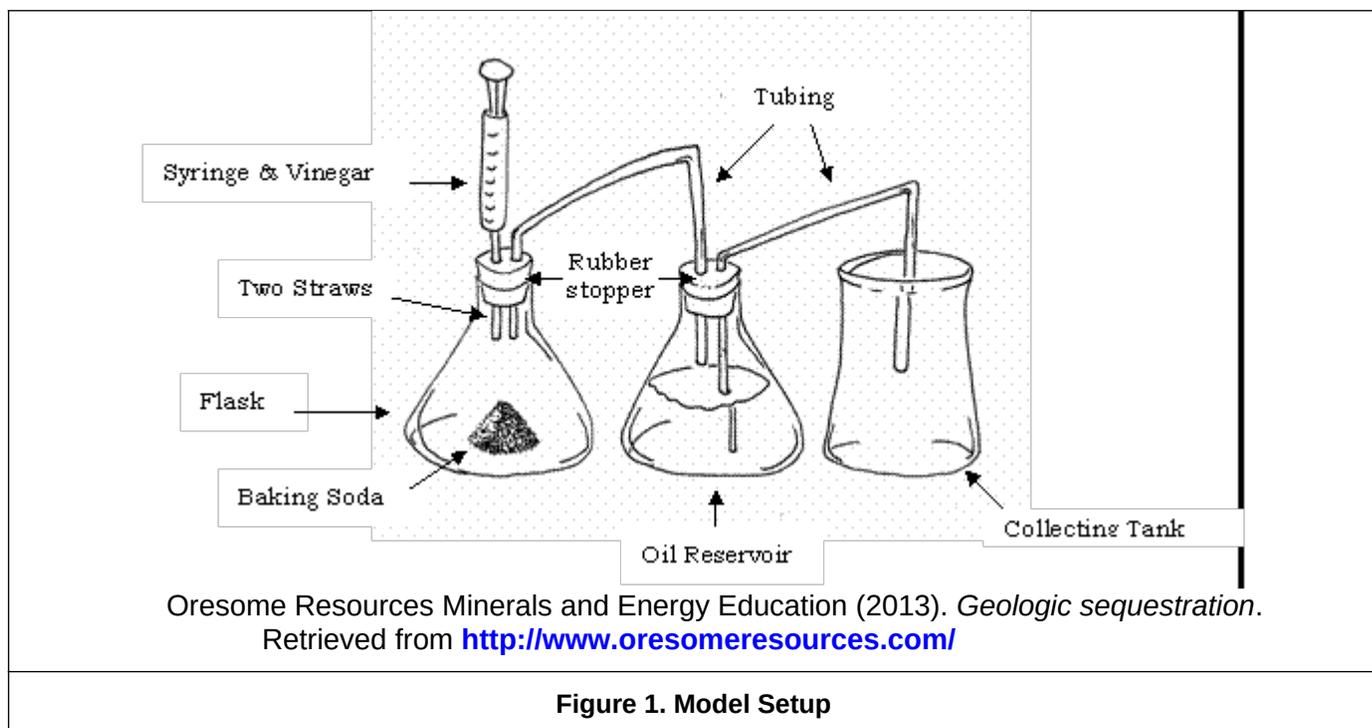
- Safety glasses
- Pencil
- *NRE Notebook*

Procedure

In this activity, you will work with your group to recover oil using a simulated enhanced oil recovery technique.

1. Collect the equipment and supplies listed in the materials above. Put on your safety glasses.
2. Use the weigh boat to measure 20g of baking soda and place in the first Erlenmeyer flask. This will be your reactor.

3. In the second flask, place 200ml of simulated oil. This will be your oil reservoir.
4. In the 100ml beaker, collect 40ml of vinegar. Draw 30 ml of vinegar up into the syringe. Make sure there are no air bubbles in the syringe.
5. Insert two 3" pieces of rigid plastic tubing in the first double hole stopper and insert the stopper into the flask containing the baking soda. Use soap solution to lubricate the tubing. **Do not force the tubing into the stoppers.**
6. Insert a 3" piece and a 6" piece of rigid plastic tubing in the second double hole stopper and insert the stopper into the flask containing the simulated oil. The 6" piece of tubing should be positioned near the bottom of the flask well under the surface. The bottom of the 3" piece should be above the oil surface level.
7. Connect one tube from the reactor to the 3" tube in the oil reservoir using flexible plastic tubing.
8. Connect the 6" tube in the oil reservoir to the second piece of plastic tubing and place it in the 250ml beaker. The 250ml beaker will serve as your collection tank.
9. Connect the syringe to the remaining 3" tube in the reactor.
10. Your model should look like Figure 1.



11. Consider each component of this system. Predict what will occur in each vessel and record in Table 1 of *Activity 7.3.3 Student Worksheet*.
12. Check the hoses for kinks and blockages. Hold the stoppers on firmly on the flasks.
13. Slowly add 10ml of vinegar to the reactor.
14. Observe the reaction in the reactor, oil reservoir, and the collecting tank and record your observations in Table 2 of your worksheet. Do not remove the syringe.
15. Slowly continue adding vinegar to the reactor until the oil stops flowing into the collecting tank.
16. Make observations as you add the vinegar.
17. Record the total oil collected in Table 2.
18. Clean up as instructed by your teacher.

Conclusion

1. What caused the oil to leave the reservoir?

The oil did not leave the reservoir.

2. Approximately what percentage of the reservoir oil was recovered? Show your calculations below. If less than 100%, why is this so?

None of the reservoir was recovered.

3. Why is the volume of oil collected so much larger than the volume of vinegar injected?

We didn't collect any oil.

4. How is this model similar to the actual EOR? How is it different?

An injection well pumps it into the production well just like the model.

5. What environmental concerns do you foresee with enhanced oil recovery methods?

Some oil may be loss which could cause some type of pollution.

Adapted from: Oresome Resources Minerals and Energy Education (2013). *Geologic sequestration*. Retrieved from <http://www.oresomerresources.com/>

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Activity 7.3.3 Student Worksheet

Table 1. Predictions

Reaction caused by baking soda and vinegar	
Effects in oil reservoir.	
Changes in collecting tank	

Table 2. Observations and Results

	Reactor	Oil Reservoir	Collection Tank
Observations after adding 10ml vinegar	Fizzed Up	Nothing	Nothing
Observation during and after additional vinegar added	Nothing	Nothing	Nothing
Total Oil Collected			0 mL