

**Sample Lesson for Earth Science A Module –Teacher**

**EARTH SCIENCE MODULE**

**EARTH AND ITS RESOURCES**

**Days Seventeen and Eighteen**

**I. Objectives**

1. TLW use a model to investigate how coal is formed from layers of plant remains that are compressed over millions of years into sedimentary rock.
2. TLW use models to investigate how geologists examine rocks or rock formations to determine locations for possible oil and gas drilling sites.
3. TLW use a model to show how geologists and engineers retrieve petroleum and natural gas from the Earth.

**II. TEKS/TAKS**

TEKS – 5.1, 5.2A-D, 5.3, 5.4A, 5.5, 5.7D, 5.11, 5.12B  
4.6A, 4.11A, 3.11A, 3.6B

TAKS Objs. – 1, 4

**III. Materials**

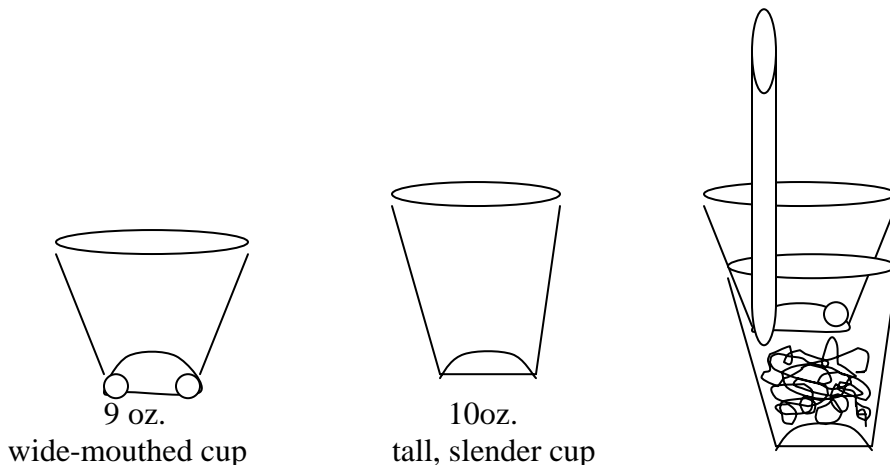
**Part A:** lab boxes with a shallow rectangular pan, 4 differently colored shredded paper samples (1 sheet of thinly shredded paper towel, 2 shredded sheets of colored copy paper, 1 shredded sheet of a different color construction paper), 1 plastic cup, water, a flat-bottomed container with a diameter of approximately 10 cm to apply pressure

**Part B:** lab boxes with 4 clear plastic cups (9 oz.), 1 with about 5 cm pea gravel, 1 with about 5 cm sand, 1 with a solid rock (granite, quartz or other rock that is not a sedimentary rock) on the bottom, and 1 with a small square of household sponge on the bottom (to represent a sedimentary rock such as limestone or sandstone), a beaker, colored water and a tray (to set cups on catch spills)

**Part C:** lab boxes with safety goggles, 1 beaker, colored water, cooking oil, two different sized beans and/or small dried macaroni, 1 drinking straw, 1 funnel with a hole at the bottom that will fit inside the straw **OR** with a hole at the bottom about the same size as the straw so that the funnel will slide tightly over the straw, 2 different sized clear, plastic cups (1 should be 9 oz. and the other 10 oz.) The smaller cup should fit snugly into the larger cup with a space of about 5 cm remaining in the bottom of the larger cup, i.e., a 9 oz. Dixie® cup set inside a 10 oz. Solo® cup.

**IV. Procedures**

1. Prior to the lab it will be necessary to prepare the materials for each part of the lab and have them ready for cooperatives groups. To avoid confusion, have groups pick up materials for one part at a time.
  - a. Part A – Use a paper cutter or shredder to cut the 4 paper samples into thin strips.
  - b. Part B – Prepare each clear plastic cup with the designated materials. Use food coloring to make a large pitcher of colored water to be used in Parts B and C, so the results will be more visible.
  - c. Part C – Prepare a cup apparatus that will be used to extract the “oil” from the “Earth” layers. **(1)** Punch 2 holes in the bottom of the smaller cup (9 oz.) so that the straw (steam delivery pipe) will fit snugly through one of the holes. Make sure the holes are directly across from each other at opposite ends of the diameter (not too close to the edge). Heat the tip of an ice pick to punch the holes through the plastic cup bottom. Enlarge the holes with the tip of a child’s scissors. **(2)** Make sure that the straw and the funnel fit snugly. If the funnel can fit into the straw, there is no problem. If they are the same size, cut tiny slits at the top of the straw and scrunch it into the funnel tightly so that water will not leak. If the funnel opening is too large, seal it with tape or modeling clay. **(3)** The macaroni and beans in the bottom of the 10 oz. cup represent layers of sedimentary rock below the surface. The cooking oil represents oil trapped in these layers. You might choose to put the oil, beans and/or macaroni in the bottom cup and have the apparatus ready to use for the first class. **(4)** Place the 9 oz., wide-mouthed cup snugly into the more slender 10 oz. cup so there is a tight seal. This is to insure that as the water is forced in through the straw, the oil is forced up into the top cup through the other hole in the 9 oz. cup.



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*Teacher note: This is such an involved lab set-up; it would be helpful to have extra bottom cups prepared for your other classes. At the conclusion of the lab, group members could remove the top cup with the straw so that the next class could use it. It is important to discuss proper disposal of the oil mixture with students so that it will not damage the environment or the plumbing.*

2. Introduce this lesson by holding a class discussion to tie in information from the previous day's lesson (the reading and visual organizer) relating to the formation, location and recovery of fossil fuels.

*Teacher note: Since this is a two-day lab, convenient stopping points might be after the discussion of Part A or Part B. The second day begins with a quick review of the concepts covered in the lab(s) of the first day.*

3. Pass out the student lab sheets and give an overview of the concepts that will be explored in the entire lab.
4. Then discuss the procedures that will be followed in Part A. Direct students to look for evidence of a cycle in the stages of coal formation.
5. Pass out lab boxes with equipment for Part A only.
6. Have groups complete Part A and share observations and conclusions as a class.
7. Next, explain Part B (focus on the properties of sedimentary rock, i.e., its ability to absorb oil and natural gas). Have groups gather lab materials and complete the investigation for Part B. Hold a class discussion to share group observations and conclusions.
8. Lastly, explain procedures for Part C. The main focus of this investigation is to look at methods and equipment scientists use to retrieve petroleum from within the Earth for consumption. Upon the completion of Part C, hold a class discussion to share observations and conclusions.
9. At the end of the last investigation on the second day, hold a discussion to review concepts covered in all three parts of the lab.
  - a. As part of the discussion, you will guide students to think about the impact on the environment of industrial methods used to recover fossil fuels for everyday use.
  - b. Emphasize how scientists research the critical attributes of matter and conditions in nature. This enables them to make an educated guess as to the locations of fossil fuels and to develop methods to retrieve them safely and economically.

### **V. Evaluation**

1. Teacher observation
2. Student work

### **VI. Extension**

As an extension, you might go to the Internet and find a website about fossil fuels. One suggested site is [www.brainpop.com/science](http://www.brainpop.com/science). This website is very good but you can only access it for 2 activities per day without subscribing.

You might also have students investigate other methods used to recover fossil fuels that were not covered in this lab. Your textbook, encyclopedias, library books and the Internet are great resources.

### **Answer Key to the Student Lab Investigation**

#### **Part A – Coal Formation**

For the first layer of “sediment”, when students pile the paper towel shreds in the water, they should observe the water being absorbed by the toweling. The shreds will still be loose. This is the first stage of coal and is called peat.

When the second layer of “sediment” is added and compressed, students will observe that now the pieces in the bottom layer of paper towel are bonded together tightly. The top layer is somewhat bonded to the second, but still has distinctive individual shreds showing. The bottom layer now represents the second stage of coal, lignite, and the top layer represents the newly formed peat.

During the third stage when the 3rd layer of “sediment” is added and then compressed, students should see that the bottom layer is almost totally bonded and most of the water is being squeezed from it. The middle layer is now almost totally bonded and wet and the top layer is loosely compacted. This model now represents the first three stages of coal, bitumen (bottom), lignite (middle) and peat (top).

After adding the last layer of “sediment” and repeating the compression, the model is complete and represents anthracite (bottom), bitumen (second), lignite (third) and finally peat (top). Students should be able to note that the water played a part in the process of plant decay and in the formation of peat. When more sand and mud cover the peat, moisture is squeezed out to form lignite (a soft sedimentary rock).

*Teacher note: Students should be guided to understand that their model is limited in that the cycle of actual coal formation happens over millions of years. By the time that peat is transformed into lignite the moisture has been squeezed out. To accommodate this, sample models should be kept for a few days so students can observe the hardening of the layers as they continue to dry out. Students should then be able to make a connection as to how sedimentary rock (coal) is formed in the Earth. The above information on the stages of coal formation should be included in a general statement in the conclusion.*

#### **Part B – Locating Fossil Fuels**

1. Students should observe the following:
  - a. Sand – The “oil” (water) will pass through the sand slowly. Some will remain in the spaces between the grains.

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- b. Gravel – The “oil” should flow through the gravel faster than the sand. Some will be trapped in the spaces between the gravel pieces.
- c. Solid rock - When the “oil” is poured on the piece of granite or quartz, it does not penetrate the rock, unless there is a crack. This would be an example of how oil can be trapped beneath a large rock layer.

Sponge – This represents a sedimentary rock such as sandstone or limestone. When the “oil” is poured on it the “sedimentary rock” (sponge) absorbs most of it.

2. In the conclusion students should discuss that geologists examine and test rocks to see which ones absorb and hold oil deposits or which ones might have an oil pool trapped beneath them. They then can look at rock formations to see where these identified rocks are located in the Earth and make an educated guess as where to drill.

### **Part C – Recovery of Fossil Fuels**

1. The scientific drawings in the observation should include:
  - a. The “before” drawing in the observation section should depict the apparatus and the labeling of its parts. The straw would be the water or steam delivery pipe. The bottom of the top cup would represent the crust of the Earth and the second hole in the bottom of this cup would represent the location of the drilling pipe. The space between the two cups is filled with “sedimentary rock” (beans and macaroni) and trapped “petroleum” (cooking oil). The bottom of the lower cup represents another rock layer.
  - b. The “after” drawing should show what happened during and after the water is forced under pressure into the “water or steam delivery pipe” (the water being poured into the funnel and through the straw). The drawing should also show the “petroleum” floating on top of the water and then some of it being forced to the surface through the “drilling pipe” (the second hole in the top cup).
2. The conclusion statement should include information about the method of oil recovery that involves water or steam being forced with great pressure into the Earth. In this process as the water or steam is forced into the Earth, the oil begins to float (property of matter) and is then forced upward to the surface through the drilling pipe. Scientist use models in the laboratory to investigate how matter will behave under different circumstances. They do this to find a method and/or a type of equipment that will perform the desired task successfully and economically in the real world. They also must use methods that will be environmentally responsible.

*Teacher note: During the discussion, point out to students that natural gas is under pressure deep in the Earth. When a hole is drilled into the Earth, and natural gas is present, it will come to the surface on its own. The water and steam is then used to recover any petroleum that is there.*