4H • ENV • 101

# Geology Project Activities Book

Oklahoma Cooperative Extension Service
Division of Agriculture Sciences and Natural Resources
Oklahoma State University

Oklahoma Energy Resources Board

OSU EXTENSION
4-H YOUTH DEVELOPMENT

# Geology Project
# Activities Section

## Book 1. Beginner

Unit 1: Rocks, fossils, minerals—Collection of 15 specimens
Unit 3: Model of an Aquifer
Unit 4: Migration Experiment
    Give it a Lift
    Muddy Microbes

## Book 2. Intermediate

Unit 1: Rocks, fossils, minerals—Collection of 30 specimens
Unit 3: Seeping Stones
Unit 4: Migration Model
Unit 5: Hungry Microbes

## Book 3. Advanced

Unit 1: Rocks, fossils, minerals—Collection of 30 specimens
Unit 2: Surfactant project


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**Printing of the Geology Project Book is funded by the Oklahoma Energy Resources Board.**

# Book 1 | Unit 1
# Rocks, Fossils and Minerals
# Collection of 15 Specimens

4-H members wanting to exhibit their rock-fossil-mineral collections should securely mount their specimens in a wooden display case with a clear cover.

Fair Class 1 may be displayed on 18” x 24” plywood or stiff cardboard that has been made suitable for hanging, although a box is recommended. Each sample should be mounted and labeled in a neat, orderly manner.

Labels should include common name, date, location found and mineral use. At least one-third of the specimens in any collection must have been added during the current project year.

If you have problems identifying a specimen, you can e-mail a picture of it to the Oklahoma State University Geology Department for assistance; however, you should not wait until the last moment to do so. Also, you should provide information as to where the specimen was collected, etc.

# Book 1 | Unit 3
# Model of an Aquifer

## Concept

A formation of rocks and soil that stores enough water for a well is called an *aquifer.* Water is drawn from an aquifer through a well. *Wells* are holes drilled into and through the layers of rocks and soil. These layers have different degrees of permeability.

Water that seeps into the ground, either from rainfall or another source, recharges an aquifer by providing it with more water. Should the area near the aquifer become polluted, the water that seeps into the aquifer will become polluted, too.

Build a small model aquifer to see how one works. You will also see how pollution affects the water that is drawn from your aquifer.

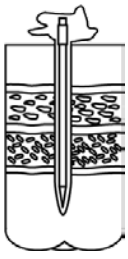
## Materials

__ 2-liter bottle
__ scissors
__ sharp knife
__ clay
__ gravel
__ top soil
__ sand
__ nylon
__ pencil
__ twist tie
__ measuring cup/glass
__ water
__ eye dropper
__ food coloring

## Procedure

1. Cut the top half off a 2-liter bottle.

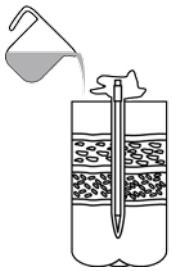
2. Layer clay, gravel, topsoil, then sand in the bottom half of the bottle. Look at the layers and compare the permeability of each material.



3. Wrap a piece of nylon around the end of a pencil. Secure it with the twist tie.

4. Make a well by drilling a hole in the layers with the pencil. Drill until you reach the layer of clay.

5. Carefully pour water in the area around the well. Does the water seep through the layers as it would an aquifer?



6. Untie the twist tie and slip the pencil out, leaving the nylon in the hole. Put the eyedropper into the well and see if you can draw water. What happened?

7. Next you will add pollution to the aquifer. Add a large amount of food coloring to the areas outside the well.

8. Continue drawing water from the well with the eyedropper. What happens?

## Concept Formation

1. What happened after you added the “pollution” to the water? How could you tell?

2. What would happen to the lakes and rivers that are fed by water from this aquifer?

3. What types of things in your home might contaminate drinking water if poured on the ground?

# Book 1 | Unit 4
# Migration Experiment

Have you ever wondered how we get oil out of rock formations and bring it to the surface of the earth?

## Concept

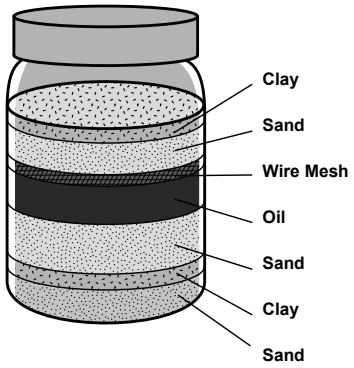
Porosity refers to the percentage of holes (pores) in the rock. Permeability is the ability of fluids to travel through porous rocks. If a well is to be successfully produced, the reservoir must have porosity, permeability and enough pressure to move the oil and natural gas to the wellbore.

## Migration

A model of oil movement within a porous substance and seal barriers.

## Materials

__ one pint jar or clear plastic cup (10 oz)
__ clean dry sand (4 cm or 130 mL)
__ 1/2 stick of modeling clay
__ vegetable oil-can be colored (10 mL/group)
__ thin mesh wire (window screen cut to fit cup)
__ centimeter ruler
__ permanent marker




## Procedure

1. Place 1 cm of sand in the bottom of the cup.

2. Press 1/2 of the clay into a thin layer and place on top of the sand, completely covering the sand. Press the clay to the sides of cup to seal.

3. Add 1.5 cm of sand on top of the clay and make a small indention, visible from the side, in the sand.

4. With a permanent marker, mark the indention on the outside of the jar.

5. Slowly add the 10 ml of oil into the indention and place the wire mesh on top of the oil reservoir.

6. Add 1.5 cm of sand and cover with the remaining clay as in step 2.

7. Make observations.

## Concept Formation

Draw a diagram of the activity and explain, in a well-written paragraph, what happened.

## What will you learn and observe…

In this activity the clay represents the impermeable rock layer, and the sand represents the permeable layer. The oil will migrate through the permeable layer (sand) and will be trapped by the impermeable layer (clay).

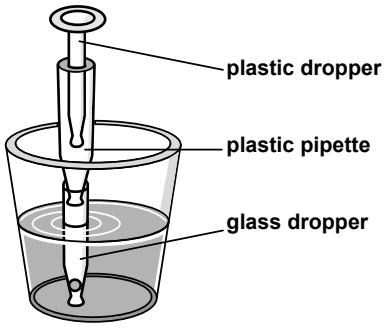
# Book 1 | Unit 4
# Give It a Lift—Part 1 & 2

## Concept

Oil can be recovered from a rock formation using artificial lifting equipment, such as a pumping unit.

## Materials

__ 8 to 10 Drinking straws
__ masking tape
__ scissors
__ can of dark-colored carbonated beverage
__ step stool or stable chair
__ volunteers (1 adult, 1 student)
__ 2 glass droppers with removable bulbs
__ 1 plastic pipette
__ 1 BB
__ container of water




## Procedure

1. Cut a 1cm slit at one end of each straw.

2. Construct one long tube (approximately 150cm or more) by joining straws end-to-end, placing the slit end into the inside of the adjoining straw.

3. Place masking tape over each connected end to secure the joint and create an air tight seal.

4. Have one volunteer stand on a step stool or chair. Insert the extended straw “tubing” into the can of carbonated beverage.

5. Instruct volunteer to try to bring the liquid to the top of the “tubing” using his/her suction.

6. Remove the bulb from the glass eyedropper. Place a BB inside the eyedropper.

7. Using the scissors, cut the bulb off the top of the plastic pipette. Cut four or five millimeters off the nose of the pipette.

8. Place the nose of the pipette into the top of the glass eyedropper (the one with the BB).

9. Remove the bulb from the plastic eyedropper. Place the nose of the plastic eyedropper inside the plastic pipette.

10. Holding the eyedropper apparatus with one hand, place the tip of the apparatus into a container of dark-colored liquid.

11. Place the index finger of your opposite hand over the open end of the eyedropper apparatus, creating an airtight seal.

12. Draw the liquid into the eyedroppers by holding the pipette and glass eyedropper with one hand and moving the plastic eyedropper up and down with the other hand. (Note: You must continue holding one finger over the open end of the dropper to maintain the airtight seal.)

## Concept Formation

1. Does the length of the straw “tubing” make a difference in the amount of suction needed to lift the carbonated beverage?

2. What kind of equipment would be needed to lift oil from rock 2,500 feet below the earth’s surface?

3. What did you discover by using the droppers to lift the liquid?

4. What would happen if the BB was removed?

5. How does this experiment relate to getting oil out of the ground?

## What will you learn and observe…

In this activity you will learn about artificial lifting systems, like pumping units, which are used to help pull the oil out of the reservoir rock and pump it up the well.

# Book 1 | Unit 4
# Muddy Microbes

## Concept

Soil and water are full of microorganisms that can have a dramatic effect on the decomposition of dead plants and animals. This process, along with heat, pressure and time, can create petroleum.

## Activity

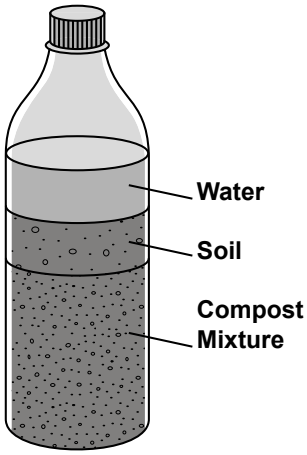
A changing model of decomposing living matter reacting and providing the element carbon which is involved in the formation of petroleum.

## Activity Preparation

Do this activity in early fall or late spring when the weather is warm.

## Materials

__ Clear plastic one-liter soft drink bottle (or clear peanut butter jar)
__ One dowel rod
__ Funnel
__ Natural soil from a garden (dry)
__ Water from a pond or creek (fresh)
__ Egg shells from hard boiled eggs (2 gm per bottle)
__ Shredded newspaper (10 x 15 cm per bottle)
__ Hard boiled egg yolk
__ Masking tape (to label and date bottles)
__ Microscope (optional)
__ Distilled water - for soil culture (optional)




## Procedure

1. Remove any stones, twigs, or lumps from the soil (Do this step outside).

2. Prepare a soil culture using soil and distilled water (This study can also be done using dried mud crackling from the edge of a pond or lake).

3. Examine microbes from soil under a microscope. Draw a diagram to show your observations.

4. Prepare a microscopic study of pond water. (Hint - using egg yolk to “feed” microorganisms should increase activity.)

5. Examine microbes from pond water under a microscope. Draw a diagram to show your observations.

6. Mix the newspaper (organic), egg shells (carbonate) and egg yolk (sulfate) with a handful of soil.

7. Pack the compost mixture in the bottom of the bottle using the dowel rod to compact the mixture and remove trapped air. The bottom layer should be a uniform depth of three centimeters.

8. Add soil to the bottle using the dowel rod to compact the soil and remove trapped air. Continue until the column is packed to within five centimeters from the top of the bottle.

9. Cover the surface of the soil with pond water, filling to the lower threads of the bottle.

10. Seal the top of the bottle tightly and place the bottle in a window that receives indirect sunlight. Temperature will affect the rate of reaction.

11. Keep the bottle and observe weekly for a minimum of three months. Record your observations. (Note: Watch for excessive buildup. Gas will need to be released as time passes. Do not remove the lid indoors as contents will produce a strong odor. Direct bottle top away from body and face.)

## Concept Formation

1. What did you observe?

2. How would this system relate to oil and natural gas formation?

3. Are microorganisms present?

4. How do these microorganisms affect the environment?

5. What are inorganic components of this system?

6. What are the organic components of this system?

7. How do living organisms affect the soil column? What evidence do you observe?

8. How do the inorganic elements affect the changes made by the living organisms?

# Book 2 | Unit 1
# Rocks, Fossils and Minerals
# Collection of 30 Specimens

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Labels should include common name, date, location found and mineral use. At least one-third of the specimens in any collection must have been added during the current project year.

If you have problems identifying a specimen, you can e-mail a picture of it to the Oklahoma State University Geology Department for assistance; however, you should not wait until the last moment to do so. Also, you should provide information as to where the specimen was collected, etc.

# Book 2 | Unit 3
# Seeping Stones

## Concept

Some rocks are porous. They have pores that allow oil to collect in the rocks.

## Materials

__ 5 rocks collected
__ Additional samples of sedimentary rocks: limestone, sandstone, shale and granite (can get from local extension office & county has kit that can be checked out)
__ 1 eyedropper or pipette per group
__ Water
__ Paper towels

## Procedure

1. Collect 5 rocks from home or school.

2. Check out samples of sandstone, limestone, shale and granite.

3. Predict and record what you think will happen when 5 drops of water on each rock.

4. Think about your findings.

## Concept Formation

1. What happens to the water? Can you select and sort the rocks that “drank” or absorbed the water?

2. What happened to the water that was not absorbed into the rocks? Why do you think some rocks absorbed the water while others repelled it?

3. Where do you think the water went when it “disappeared?”

# Book 2 | Unit 4
# Migration Model

Have you ever wondered how we get oil out of rock formations and bring it to the surface of the earth?

## Concept

Porosity refers to the percentage of holes (pores) in the rock. Permeability is the ability of fluids to travel through porous rocks. If a well is to be successfully produced, the reservoir must have porosity, permeability and enough pressure to move the oil and natural gas to the wellbore.

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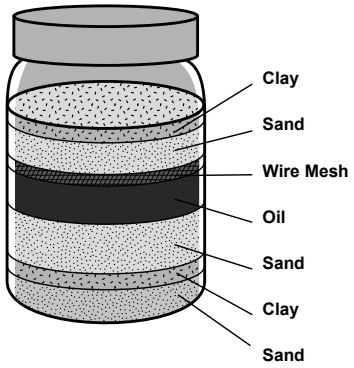


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# Book 2 | Unit 5
# Hungry Microbes

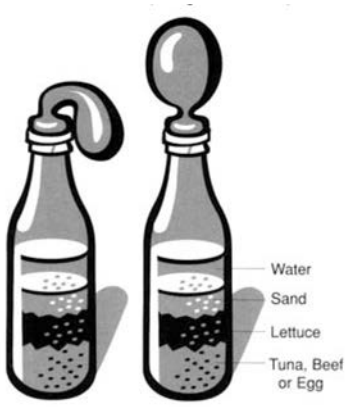
Have you ever thought about how natural gas is formed? Where would you find natural gas?

## Concept

Natural gas is a substance formed over millions of years from decaying ocean plants and animals.

## Materials

__ 10 grams raw beef, 10 grams tuna, or 1 hard cooked egg with shell
__ 2 lettuce leaves
__ Clear plastic bottle (1 liter)
__ 1 balloon
__ Graduated cylinder
__ 50 grams sand
__10 ml aquarium or pond water
__ Masking tape
__ Balance scale/weights




*Note: This activity can be done with a sealable baggy in place of the bottle and balloon.*

## Procedure

1. Measure 10 grams of an organic substance and put it in bottle. Tear the lettuce leaves into small pieces and put them in the bottle.

2. Use the balance scale to measure 50 grams of sand. Carefully pour the sand into the bottle so that the sand covers the organic substance and lettuce. Do not shake the bottle.

3. Measure 10 ml of water. Slowly pour the water into the bottle. Try to make the water run down the inside of the bottle instead of pouring the water directly on the sand.

4. Stretch the opening of the balloon over the opening of the bottle. Seal with masking tape.

5. Carefully move the bottle to a warm place (preferrably outside as contents could produce a strong odor). Let bottle stay in that place for several days.

6. Predict what will happen over the next few days.

7. Design a chart and record your daily observations (changes in the balloon, etc.).

## Concept Formation

1. Summarize data and draw conclusions.

2. What do you think caused the changes in the balloon?

3. What happened to the materials in the bottle as time passed? What name could we give this newly formed substance?

4. How did the substance change?

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# Rocks, Fossils and Minerals
# Collection of 30 Specimens

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# Book 3 | Unit 2
# Surfactant Experiment

Each time you have tried to mix oil and water they have never mixed. You can shake a bottle containing both of these items, but they never truly mix. So is there a way to make them mix?

## Concept Formation

By utilizing a surfactant as a secondary recovery technique, additional oil can be removed from the reservoir, that would not have previously been retrieved.

## Materials

__ One liter drinking water container
__ Water (enough to fill up 1/2 of the container)
__ Cooking or vegetable oil (enough to form a thin layer on the surface of the water)
__ 5 ml of liquid detergent

## Procedure

1. Place water in a small container such as a drinking water or one liter bottle. Add enough cooking oil to form a thin layer that covers the surface of the water. Note that these two liquids are immiscible.

2. Follow the guidelines below.
    1. Sketch the layers of oil and water
    2. Write down 5 observations regarding the layers
    3. Stir the oil and water
    4. Write down 5 additional observations following stirring
    5. Wait 15 minutes and describe the water and oil layers
    6. Add a small amount (approximately 5 ml) of liquid detergent to the container
    7. Write down observations after adding detergent
    8. Stir the mixture and describe the results

3. What is different about the behavior of the oil and water in steps 1 through 5 as compared to steps 6 through 8?

## Concept Formation

1. Did the oil and water stay mixed for any longer lenth of time during the experiment? If so, when?

2. Can you relate this to oil and natural gas and secondary recovery methods?

# Fair Exhibits & Classes

- Any eligible 4-H member may participate in collecting, identifying and preparing a rock-fossil-mineral exhibit or preparing an energy and petroleum exhibit.
- There is no limit on the number of entries per county. An Individual 4-H member can enter one exhibit per class.
- Ribbons will be placed on the top ten in each class. Premiums will be paid on the top five in each class as follows: **1st-$5, 2nd-$4, 3rd-$3, 4th-$2, 5th-$1**
- 4-H members wanting to exhibit their rock-fossil-mineral collections should securely mount their specimens in a wooden display case with a clear cover.
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- Labels should include common name, date, location found and mineral use. At least one-third of the specimens in any collection must have been added during the current project year.

## Class

1. Fifteen (15) different unpolished rocks, minerals or fossils collected from Oklahoma.

2. Thirty (30) different unpolished rocks, minerals or fossils, including specimens of sedimentary, igneous and metamorphic.

3. Open Class - Educational exhibit depicting some phase of geology, testing of minerals, polished rocks, etc. (Display should not exceed 24" x 24".)

## Energy/Petroleum Exhibits

Posters must be on 14" x 22" poster board. Each must be signed and dated on the back in permanent marker prior to laminating. Judging committee may mark or punch if not marked. Text of posters and displays should be readable from at least 10 ft. away**.** Displays should be self standing and not bigger that 3' x 3' when sides are extended.

## Junior Division (Ages 9-12)

4. Poster on well site safety.

5. Energy/Petroleum Display. Subject of the display should be petroleum products; different types of energy and how they work; or different careers in energy.

6. Energy or Petroleum Science Experimental Display (Science-Fair type.) 4-H members are encouraged to (a.) use their 4-H projects as the basis for their scientific research and discovery; (b.) use the scientific method to gain an understanding of how things work and the variables that affect them; (c.) take an open and creative approach to problem solving; (d.) learn that a successful outcome is based not on personal opinion but on scientific fact; & (e.) use written and visual communication skills.

## Intermediate Division (Ages 13-14)

7. Photography Exhibit over a state park or geological region. Four photos mounted on 14" x 14" poster board with detailed explanations and information.

8. Poster on Water Mineral Issue. Subject of poster should be one of the following:
    - What water hardness and mineral testing can determine.
    - Secondary recovery methods
    - Dangers of lead in the water

9. Energy or Petroleum Science Experimental Display (Science-Fair type.) 4-H members are encouraged to (a.) use their 4-H projects as the basis for their scientific research and discovery; (b.) use the scientific method to gain an understanding of how things work and the variables that affect them; (c.) take an open and creative approach to problem solving; (d.) learn that a successful outcome is based not on personal opinion but on scientific fact; & (e.) use written and visual communication skills.

## Senior Division (Ages 15 and over)

10. Poster of a press release collected about the energy information and your interpretation.

11. Energy or Petroleum Display. Subject of the display should be areas economic impact from the energy industry in Oklahoma; different drilling techniques and how they work; or careers in the energy industry.

12. Energy or Petroleum Science Experimental Display (Science-Fair type.) 4-H members are encouraged to (a.) use their 4-H projects as the basis for their scientific research and discovery; (b.) use the scientific method to gain an understanding of how things work and the variables that affect them; (c.) take an open and creative approach to problem solving; (d.) learn that a successful outcome is based not on personal opinion but on scientific fact; & (e.) use written and visual communication skills.