



Title: Oil and Natural Gas in Arkansas – Lesson 1: How They Form			
Course: Science, Language Arts, Library Media Grades: 5-8		Duration: 3 Class Periods (3 Hours)	
Arkansas Standards:			
Subject:	Grade:	Code:	Standard:
Science	5	5-PS1-4	Conduct an investigation to determine whether the mixing of two or more substances results in new substances. [AR Clarification Statement: Examples of qualitative evidence could include temperature change, color change, odor change, and the formation of a gas to determine if a new substance has formed.]
		5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]
	7	7-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [AR Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrochloric acid.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]
		7-ESS3-1	Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy, and groundwater resources are the result of past and current



			<p>geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]</p>
		7-ESS2-3	<p>Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, or trenches).] [Assessment Boundary: Paleo-magnetic anomalies in oceanic and continental crust are not assessed.]</p>
8		8-ESS1-4	<p>Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of Homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains or ocean</p>



			basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]
Language Arts	5	RI.5.2	Examine a grade-appropriate informational text. <ul style="list-style-type: none"> ● Provide a summary. ● Determine the main idea of a text and explain how it is supported by key details.
		RI.5.4	Determine the meaning of general academic words and domain-specific words and phrases in a text relevant to a Grade 5 topic or subject area.
		RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
	6-8	RI.6.1 RI.7.1 RI.8.1	Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
		RI.6.2 RI.7.2 RI.8.2	Examine a grade-appropriate informational text. <ul style="list-style-type: none"> ● Provide an objective summary. ● Determine a central idea in a text and analyze its development.
		RI.6.4 RI.7.4 RI.8.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.
Library Media	5-8	IL.1.5.1 IL.1.6.1 IL.1.7.1 IL.1.8.1	Utilize knowledge of school library media center organization to locate resources by referring to <ul style="list-style-type: none"> ● major sections (e.g., fiction, nonfiction, reference, digital resources, periodicals, special collections) ● statement of responsibility (e.g., author, editor, illustrator) ● Dewey Decimal Classification System



		IL.1.5.5 IL.1.6.5 IL.1.7.5 IL.1.8.5	Utilize text features to locate information for a specific purpose (e.g., headings, bold print, illustrations, italics, electronic menus, icons, subheadings, diagrams, key words, sidebars, hyperlinks, captions, tabs, maps, photographs, boxed text, drop-down menus, charts, graphs, timelines, animations, interactive elements on Web pages, topic sentences).
		IL.1.5.9 IL.1.6.9 IL.1.7.9 IL.1.8.9	Utilize sources of information outside the school library media center (e.g., people, public libraries, digital resources, museums, virtual tours, special libraries).
Instructional Strategies: Cooperative Learning, Generating and Testing Hypothesis, Brainstorming and Discussion, Drawing, Word Web, Labs			
Blooms Levels: Analyzing, Understanding; Remembering			
Materials: Specific Materials are listed for each Activity/Lab in the lesson.			
Resources Specific Resources are listed for each Activity/Lab in the lesson.			
Formative Assessment Comprehension and Interpretation/Analysis Questions accompany/follow each Activity/Lab.			

Teacher Notes:

Crude oil and natural gas or petroleum, along with coal, are classified as fossil fuels. What does this mean? A fuel is anything that can be consumed to produce energy. Fossils are the remains of a once living thing. Fossil fuels, therefore, are materials that formed from the remains of once living organisms that can be converted into energy through the process of combustion. Formation of fossil fuels requires processes that require millions of years to complete so are considered a nonrenewable resource.

The general sequence of this process includes: death, deposition, burial, decay, heat/pressure, and accumulation. Coal forms from the remains of plants that lived in swampy environments. Oil and natural gas form primarily from the remains of microscopic animals and plants that lived in the water of oceans, lakes, and rivers. Heat and pressure due to burial under many hundreds to thousands of feet of sediment cause the organic material to undergo changes that convert them first to kerogen then to coal, oil, or natural gas. Crude oil is a complex liquid composed of several different hydrocarbon compounds. Natural gas is primarily methane a simple hydrocarbon with the chemical formula CH₄. There may also be ethane (C₂H₆), propane (C₃H₈) and butane (C₄H₁₀) found with the methane.



Student Handouts:

- Student Handout 1 Activity 1 – What I Already Know
- Student Activity 2 Activity 2 – What Are Fossil Fuels
- Student Handout 3 Lab 1 – Fossils
- Student Handout 4 Lab 2 – Organic Matter and Natural Gas

Pre-assessment Questions:

These questions can serve as a means of opening the discussion of oil and natural gas as well as determine the level of knowledge and conceptions that the students already have.

1. What are oil and natural gas?
2. Where do they come from?
3. What are they used for?

Background Information:

This publication is a great introduction to the process of locating and extracting oil and natural gas deposits. It is written for the general public and is highly recommended for any teacher who needs background information on the oil and gas industry. (Curtis, Doris et al. How to try to Find an Oil Field. Tulsa, Oklahoma. Penn Well Publishing. 1981.)

Suggested websites to present background/introductory information to the students. These web sites may change over time. If a web site is no longer available, use the key words and phrases to find more current resources

Energizing Life: The Story of Oil and Natural Gas (Introductory video)

<http://www.api.org/story/index.html>

Introductory animations on oil and natural gas and how they form

<https://adventuresinenergy.org/What-are-Oil-and-Natural-Gas/index.html>

Animation about oil formation.

http://www.hk-phy.org/energy/power/source_phy/flash/formation_e.html

Student Handouts: See web site for a printable copy:

<http://www.arkansasenergyrocks.com/educators/lesson-plans-k-8/>



Student Handout 1

Lesson 1 – Oil and Natural Gas: How They Form

Activity 1 – What I Already Know

Instructions:

Brainstorm what you already know about fossil fuels and create a web graphic organizer.

FOSSIL FUELS



Student Handout 2

Lesson 1 – Oil and Natural Gas: How They Form Activity 2 – Fossil Fuels

Instructions:

Use the following websites to answer the questions below. These websites may change over time. If a web site is no longer available, use the key words and phrases below to find more current resources. Some suggestions are:

- Fossils
- Fossils of Arkansas
- Fossil fuels
- Fossil records
- Energy sources—renewable and non-renewable
- Energy choices

Getting Into the Fossil Record—University of California Museum of Paleontology

<http://www.ucmp.berkeley.edu/education/explorations/tours/fossil/5to8/Intro.html>

U.S. Energy Information Administration—Nonrenewable Energy Explained

http://www.eia.gov/energyexplained/index.cfm?page=nonrenewable_home

American Petroleum Institute—Oil and Natural Gas Overview—Energy Source, Energy Choices

<http://www.api.org/oil-and-natural-gas-overview/classroom-tools/classroom-curricula/energy-source-choices>

Fossils of Arkansas

https://www.geology.arkansas.gov/docs/pdf/education/Fossil_Poster.pdf

<https://www.geology.arkansas.gov/geology/fossils.html> Define fossil.

1. Define fossil.



2. Describe how fossils form.

3. What is a fuel?

4. List the three forms of fossil fuels.

5. Why are they described as “nonrenewable”?

6. What are some of the issues related to fossil fuel use?



7. Are there other types of fuels that are not fossil fuels? List.

8. What is the difference between an invertebrate and a vertebrate animal?

9. Most of the fossils in Arkansas are marine invertebrates. What does this mean?

10. Why are fossils important?



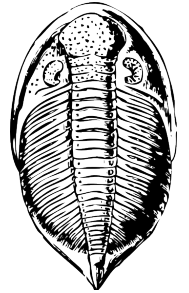
Student Handout 3

Lesson 1 – Oil and Natural Gas: How They Form

Lab 1 – What Are Fossils?

Introduction

In the previous activities you learned that oil and natural gas are known as fossil fuels. You will now investigate the concept of a “fossil” in more detail. A fossil is the remains of a once living organism. Fossils come in two basic types: body and trace. Body fossils are the organism itself, some part, or an impression of it. Trace fossils are evidence of an organism’s presence like a footprint or trail. In this lab you will observe the characteristics of different kinds of plant and animal fossils.



Materials

- Bag or box of 8 fossil specimens*
- Magnifying glass
- Fossil book(s)

(*Fossil specimens can be obtained through educational supply houses like Wards Natural Science, personal collections can also be made of local fossils by consulting the Arkansas Geological Survey publication *Fossils of Arkansas* by Tom Freeman.)

Procedure

1. Remove the fossil specimens and lay them out on your desk.
2. Use your senses to carefully observe each specimen, use the hand lens if necessary.
3. Make a detailed drawing of each fossil.
4. Based on your observations, you will hypothesize whether each fossil is a body part or a trace of an organism. Record your hypothesis in the data table.
5. Now use your observations to hypothesize if each fossil represents a plant or an animal. Record your hypothesis in the data table.
6. Use the fossil book(s) to identify each fossil.
7. Use the fossil book(s) to determine if your hypotheses were correct and record the answers in the data table.



Actual	Is the Fossil a Plant or Animal?				
	Is the Fossil a Body or Trace Fossil?				
Identification					
Hypotheses	Is the Fossil a Plant or Animal?				
	Is the Fossil a Body or Trace Fossil?				
Drawing					



Analysis and Conclusions

1. Which fossils give a more complete image of the entire organism?

2. What characteristic of the animal fossils allowed them to be preserved?

3. What do you think was necessary for the plant fossils to be preserved?

4. Which of the animal fossils are invertebrates? Vertebrates?



5. What conclusions can you reach about the environment that each of the organisms lived in?

References

Freeman, Tom. Fossils of Arkansas. Little Rock, Arkansas: Arkansas Geological Commission, 1989.

Potts, Joanna, ed. Guide to Fossils. Buffalo, New York: Firefly Books, 2003.

Rhodes, Frank H.T., Zim, Herbert S., Shaffer, and Paul R. Fossils: A Guide to Prehistoric Life. A Golden Nature Guide. New York, New York: Golden Press, 1962.

Thompson, Ida. National Audubon Society Field Guide to North American Fossils. New York, New York: Alfred A. Knopf, 1995.

Walker, Cyril and Ward, David. Fossils. Smithsonian Handbooks. New York, New York: Dorling Kindersley, 2002.



Student Handout 4

Lesson 1 – Oil and Natural Gas: How They Form

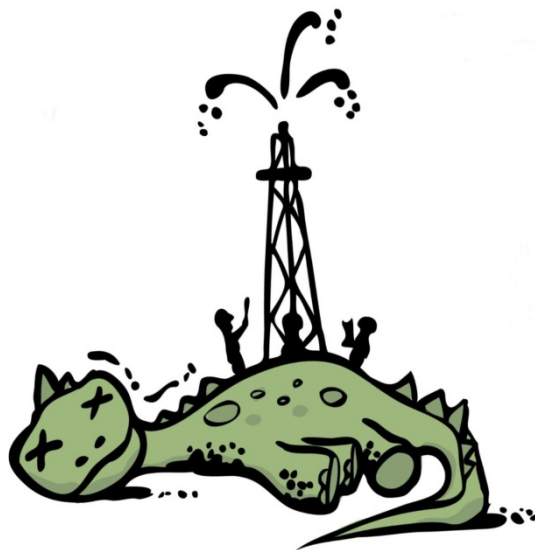
Lab 2 – Organic Matter and Natural Gas

Introduction

In this lab students will observe the connection between the decay of organic material to the formation of natural gas.

Materials

- 2 plastic water bottles
- Organic substance (tuna, ground beef, or egg)
- Lettuce
- Sand
- Balloon
- Water
- Masking tape
- Balance scale



Procedure

1. Measure 10g of an organic substance (tuna, beef, or egg) and put into bottle.
2. Tear the lettuce leaves into small pieces and put into bottle.
3. Use the balance scale to measure 50g sand. Carefully pour the sand into the bottle so that it covers the organic substance and lettuce. Do not shake the bottle.
4. Measure 10ml of water. Slowly pour the water into the bottle. Try to make it run down the inside of the bottle instead of pouring it directly onto the sand.
5. Stretch the opening of the balloon over the opening of the bottle. Seal with masking tape.
6. Prepare a second bottle without the organic material. This will be a control bottle.
7. Put both bottles in a warm place (preferably outside as contents could produce a strong odor).
8. Over the next several days you will be making observations of both bottles describing changes to the balloon and the material in the bottles.



Results

Day	Bottle with Organic Material		Control Bottle	
	Describe Changes to the Balloon	Describe Changes to the Material	Describe Changes to the Balloon	Describe Changes to the Material
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				



Analysis and Conclusions

1. What is causing the balloon to expand?

2. Is there a difference in the balloons between the two bottles? Why?

3. Based on the observations of both bottles, what can you conclude about the origin of the gas that filled the balloon?
