Title:	Natural Gas and Oil Formation	
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Course: **Grade:**	Earth Science, Environmental Science, Biology Inclusion 9-12	**Duration:** 1 day

Objective:
Students will learn that oil and natural gas taken from the earth's crust today originated as small plants and animals that lived in the ocean millions of years ago.

Summary of Lesson:
In this lesson the students will engage in hands on activities discovering how the formation of gas and oil occurred over time.

Arkansas State Standards:

SUBJECTS:	GRADE LEVELS:	CODE:	STANDARD:
Earth Science	**9-12**	**ES-ESS1-6**	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
		ES-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
		ES-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
Environmental Science	**9-12**	**EVS-ESS2-6**	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
Biology	**9-12**	**BI-ESS2-6**	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
		BI-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
Language	**9-12**	**RI.9-10.2**	Examine a grade-appropriate informational text. ● Provide an objective summary of the text.

Arts			● Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details.
		RI.11-12.2	Examine a grade-appropriate informational text. ● Provide an objective summary of the text. ● Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis.
		RI.9-10.4 **RI.11-12.4**	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone.
		W.9-10.2 **W.11-12.2**	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Teacher Excellence Support System (TESS):
Domain 3c Engaging students in learning

Instructional Strategies and Practices: (
Marzano: Students will identify similarities and differences. Marcia Tate Instructional Strategies: students will draw and brainstorm how to sketch the information.

Bloom's Level: Highest Level Only
Synthesis
(Student design land formations from 570 million years ago, 320 million years ago, 250 million years ago and today.)

Materials and Resources:

- White copy paper
- Colored pencils
- Markers, crayons, and rulers
- Students can use biology textbooks and chrome books to check accuracy of drawing.

Formative Assessment:
Student illustrations, Exit Questionnaire (Answer Key) (See Student Handout Exit Questionnaire)

Notes to Teacher:
Students need some prior knowledge of geological timelines. Many excellent websites and charts can be found to display in the classroom. The following site has an excellent chart that follows what the lesson emphasizes:

https://www.geosociety.org/GSA/Education_Careers/Geologic_Time_Scale/GSA/timescale/home.aspx
An excellent video for introduction:
http://www.youtube.com/watch?v=_8VqWKZIPrM

(These websites may change over time. If a website is no longer available, use key words and phrases from the lesson plan to find more current resources.)

Student Activity

1. Find several computer images of Paleozoic through Cenozoic timelines to show students before the activity begins (examples are listed). This will give them some basic ideas about creating their own timeline illustration.

   http://www.fossils-facts-and-finds.com/paleozoic_era.html

   http://www.livescience.com/37584-paleozoic-era.html

   http://www.encyclopedia.com/topic/Mesozoic_era.aspx

   http://www.fossils-facts-and-finds.com/cenozoic_era.html

   http://www.livescience.com/40352-cenozoic-era.html

(These web sites may change over time. If a web site is no longer available, use the key words and phrases from the lesson to find more current resources.)

2. Hand out white blank paper and appropriate art supplies to each student. The student will divide the paper into 3 sections. As the teacher reads each section of the Paleozoic through Cenozoic Timeline, the students will sketch the information as the teacher relays it to them.

3. Use the following script to describe the three eras.

   ***570 million years ago**—during a period known as the "Paleozoic Era" a large sea covered the area we now recognize as the southern part of the United States. In this sea lived a vast number of microscopic plants and animals called plankton. This microscopic plankton drifted on or near the surface of the water and became so numerous that it could actually be seen with the naked eye. Throughout the "Paleozoic Era" the sea was also alive with trilobites, corals, crinoids, brachiopods, and many other plants and animals which evolved over millions of years.*

A trilobite was a strange-looking little creature. Small grooves divided its body and hard-segmented shell into three vertical parts. A semicircular shield covered its head. Coral, which still exists today, came in many different sizes, shapes and colors. The coral polyps were simple animals that were able to take calcium out of saltwater and convert it into a rocklike shelter, in which they lived. Crinoids anchored themselves to rocks on the sea floor with a root-like structure that supported a stalk or column topped by a cup-like cavity, which formed a protective case for a flower. Brachiopods were clam-like animals. Their two-piece dorsal and ventral shells enclosed and protected their soft body parts.

Due to their ability to reproduce quickly, the plankton, along with other sea life was abundant. As these carbon-containing organisms went through their extremely short life cycles and died, their remains sank to the deep sea floor and became covered with the mud, sand and sediment from the eroding mountains and surrounding areas. Because they were buried so quickly on the deep sea floor, the plankton and other sea creatures lacked oxygen, which is necessary for decay or decomposition.

***320 million years** passed, and layers of sediment on the sea floor became thousands upon thousands of feet deep. These layers were filled with dead plankton, fossilized sea creatures and eroded rock!*

During the time period known as the "Mesozoic Era," dinosaurs began to roam the earth and swim in the sea. More than half of the great sea had disappeared because of evaporation, earthquakes, and the filling and layering of sediments on the sea floor. This heat and pressure was responsible for changing the dead organic material into hydrocarbons and causing the remaining inorganic material to change into sedimentary rock.

***250 million years** later brings us to present day – the "Cenozoic Era. People now walk the earth and the dinosaurs have long since disappeared. The erosion and other sediments have now completely filled the seas.*

The heat and pressure have formed many layers of sedimentary rock, and deep source rock – rock where oil and natural gas form. Much of the water that was in the sea is now in the pore spaces of the sedimentary rock. The remaining water evaporated or was pushed into areas where seas or oceans now exist.

Over millions of years, temperatures ranging from 150-300 degrees Fahrenheit have "cooked" the organic materials causing a complex chemical change, creating hydrocarbons called oil and natural gas. These hydrocarbons are also known as fossil fuels.

As you finish the last scene, keep in mind that there are different theories of fossil fuel creation. Two of these are Biogenic theory and Abiogenic theory. You have just drawn the formation of oil and natural gas based on the biogenic theory. It is the most widely accepted by geologist.

4. Have students use a computer with internet access to locate the definition of the biogenic and abiogenic theory and write a short description contrasting the two theories.

5. **Conclusion:** Ask students to complete **Student Handout: Exit Questionnaire** and submit it with their computer research.

Student Handouts: A printable copy of the handout is available at:
https://arkansasenergyrocks.com/educators/lesson-plans-9-12/

Exit Questionnaire Answer/ Key (See **Student Handout Exit Questionnaire** that follows.)

1. Explain the formation of oil and natural gas according to the biogenic theory.
Answer: As small organisms called plankton die they sink to the bottom of the sea. There they are buried by sediments of the ocean floor. After years and years heat and pressure chemically change the plankton into oil and natural gas.

2. Heat and pressure have formed many layers of _____ rock, a deep source rock where oil and natural gas forms.
Answer: B Sedimentary Rock

3. As tiny _____die and sink to the bottom of the sea, they add the carbon containing chemicals in their bodies to the sediment and mud on the ocean floor. Over time the mud becomes solid rock. Under great heat and intense pressure chemical reactions change the _____ into _____ _____.
Answer: Plankton, Plankton, Fossil Fuels

Student Handout
Natural Gas and Oil Formation
Exit Questionnaire

1. Explain the formation of oil and natural gas.

Questions

2. Heat and pressure have formed many layers of _____ rock, a deep source rock where oil and natural gas forms.

a. Volcanic
b. Sedimentary
c. Igneous
d. Metamorphic

3. As tiny _____die and sink to the bottom of the sea, they add the carbon containing chemicals in their bodies to the sediment and mud on the ocean floor. Over time the mud becomes solid rock. Under great heat and intense pressure chemical reactions change the _____ into _____ _____.