



Title: Digging Into Energy from Arkansas Rocks--A Unit for Discovery			
Author: Amanda Smith-Jones Poyen High School Poyen, AR			
Course: Science, Language Arts, Arkansas History		Duration: 5 to 7 45-minute class periods	
Grade Level: 7			
Objective: The student will be able to differentiate between the three categories of rocks and discuss the energy found in a specific type of sedimentary rock called shale. In addition they will learn the types of drilling methods employed to extract the energy resources from this type of rock. They will learn more about oil and natural gas production from experts who visit the class or from online experts who answer student's questions.			
Summary of Lesson: This unit consists of five lessons to teach students the three categories of rocks and then requires students to take a closer look at one of those categories – sedimentary rocks—by making their own model of a sedimentary rock. Once the models are made the teacher will then introduce a common sedimentary rock called shale and explain its link to oil and natural gas production in Arkansas. Students will interview experts about the impact of oil and natural gas production on the state and will learn more about careers in this industry.			
Arkansas Standards:			
Subject:	Grade:	Code:	Standard:
Language Arts	7	RI.7.2	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.
		W.7.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
		W.7.7	Conduct short or more sustained research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.
		SL.7.1	Engage effectively in a range of collaborative discussions <ul style="list-style-type: none"> ● one-on-one ● in groups



			<ul style="list-style-type: none"> • teacher-led with diverse partners on Grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly
		SL.7.3	Determine a speaker's argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence.
Science	7	7-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
		7-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
		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 geoscience processes.
Arkansas History	7-8	G.1.AH.7-8.2	Analyze the availability of resources and their effects on the development of each geographic region of the state (e.g., diamonds, bauxite, oil, timber, agricultural, wild game)
<p>Teacher Excellence and Support System: Domain 3 – Focus on 3a Communicating with Students, 3b Using Questioning and Discussion Techniques, 3c Engaging Students in Learning</p>			
<p>Instructional Strategies and Practices: The lessons related to this topic focus mainly on STEM (Science, Technology, Engineering, and Mathematics)</p>			
<p>Bloom's Level: <i>(Highest Level Only)</i> Creating – design, create, invent</p>			
<p>Materials and Resources:</p> <p><u>Day 1</u></p> <ul style="list-style-type: none"> • Copies of Student Handout: <i>Lesson 1: Categories of Rocks</i> (See Student Handout section and the printable file from the web site.) • Rock samples—sedimentary, metamorphic, igneous—enough for several students to use at once <p><u>Day 2</u></p> <ul style="list-style-type: none"> • Copies of Student Handout: <i>Lesson 2: Teach About Rocks</i> (See Student Handout section and the printable file from the web site.) 			



- Texts, magazines or handouts with information about types of rocks
- Construction paper for each group
- Glue or tape for all students
- Markers / crayons / scissors/writing utensils for all students

Day 3

- Copies of Student Handout: *Lesson 3: Sedimentary Rocks* (See Student Handout section and the printable file from the web site.)
- Sedimentary rocks containing fossils
- Disposable plastic gloves
- Paper towels
- Sedimentary Sandwich ingredients
 - Loaf of white bread
 - Loaf of brown bread
 - Graham cracker crumbs
 - Red jam
 - Purple jam
 - Raisins
 - Crunchy peanut butter (Modify this ingredient if you have students with peanut allergies.)
 - Animal shaped crackers or candy (optional)
- Plastic knives, forks and spoons—one per student
- Paper plates—one per student

Day 4

- Copies of Student Handout: *Lesson 4: Drilling for Oil and Natural Gas* (See Student Handout section and the printable file from the web site.)
- Straws of various sizes (regular, coffee, bendable) for all students (These might be donated from local fast food restaurants)
- String for all students
- Popsicle sticks for all students
- Toothpicks for all students
- Classroom scale (must be able to weigh less than an ounce)
- Small paper cups for all students
- Cream -filled cupcakes, one for each student (Check with a local grocer to see if these can be donated). The cupcakes must all be the same.
- Chart for recording results of engineering design in *Lesson 4: Drilling for Oil and Natural Gas* (See Student Handout section and the printable file from the web site.)

Day 5

- Copies of Student Handout *Lesson 5: Ask an Expert* (See Student Handout section and the printable file from the web site.)



General Resources

Computers and/or iPads with internet access.

Use key words and terms to search the internet for videos and websites that provide information on sedimentary rock, drilling for oil and gas in shale deposits; fracturing, etc.

Suggested web sites:

- <https://www.geology.arkansas.gov/>
Arkansas Geological Survey has some great resources.
- <http://energy4me.org/>
A site with **free classroom materials** to teach about energy resources and request a classroom speaker. Features information about careers in energy; includes pre-made teacher ready lesson plans and free downloadable/printable lesson materials.
- <https://www.api.org/oil-and-natural-gas/consumer-information/in-the-classroom/online-education-resources>
Resources for educators and students that explore the topic of energy. Follow the links to find useful educational tools.
- <http://www.youtube.com/watch?v=eOuPsJwYu9I> (Geology Kitchen Series)
Explains the three types of rocks and describes how sedimentary rocks are made.
- <http://www.youtube.com/watch?v=NyggkD8uATng>
Describes how sedimentary rocks are made.
- <http://www.pages.drexel.edu/~ks73/Ediblerocks.htm>
Describes how to make an edible model of an igneous, sedimentary rock like shale, and metamorphic rock.
- www.chevron.com/deliveringenergy/naturalgas/shalegas/howweoperate/
Video of shale drilling.
- www.neok12.com/Natural-Resources.htm -- Video of oil drilling
Scroll down to watch videos; click on Offshore Drilling (2:50), and then watch Extreme Oil Drilling (3:00)

EXTENSION: Game for oil drilling

<https://www.learntodrill.com/drilling-games>

There are several oil-drilling games on the Internet that allow students to simulate the drilling process. This site reviews seven games and allows download. Or conduct an Internet search using the key words: oil drilling game.

Formative Assessment:

The lessons have activities, assignments or questions that can be used for exit slips or assessments. Use a question from the lesson as review to start the new lesson the following day – it's an entrance slip instead of an exit slip

Teaching Notes:

All background knowledge and lesson specific notes are provided in this unit. Each lesson builds on previous lessons thereby providing all necessary information as students move



through the unit.

Background:

Rocks come in all kinds of colors, shapes and sizes, but geologists can organize them into three basic categories—sedimentary, igneous and metamorphic. They classify them based on how they were formed.

Igneous rocks are formed from melted rock that has cooled and hardened. When rocks are buried deep within the Earth, they melt because of the high pressure and temperature; the molten rock (called lava or magma) can then flow upward or can be blown out from a volcano onto the Earth's surface. There are two basic types of igneous rocks. There are the rocks that make it to the surface (extrusive) and the ones that are stuck in the crust just below the surface (intrusive). Geologists describe different igneous rocks according to their texture and composition

Sedimentary rocks are formed at the surface of the Earth from particles of sand, shells, pebbles, and other fragments of material. The particles are pieces of a different, pre-existing rock that have been weathered and transported by wind, water, ice, or gravity and accumulate in layers. Over long periods of time, the layers are compressed and harden into rock. This process can take place in water or on land. Generally, sedimentary rock is fairly soft and may break apart or crumble easily. You can often see sand, pebbles, or stones in the rock. It is usually the only type that contains fossils. Chemical sedimentary rocks form from minerals that have been dissolved in water and settle out, forming a solid rock. Geologists describe sedimentary rocks according to the size and shape of the particles in them or their mineral composition (in the case of chemical sedimentary rocks).

Some sedimentary rocks contain fossils. Fossils are the remains or imprints of once living organisms. These remains often get trapped in sediment and as layers of sediment form atop one another a fossil is embedded in the rock. Look at the sample sedimentary rocks at your table that contain fossils. Discuss within your group how you think those fossils were formed.

Shale is the most abundant type of sedimentary rock and is found worldwide. In Arkansas, we have two areas of shale where natural gas is found - the Arkoma Basin in western Arkansas and eastern Oklahoma and in The Fayetteville Shale which covers ten counties from western to eastern Arkansas. Millions of dollars of natural gas is produced in Arkansas every day. In fact, Arkansas now ranks as the 8th leading natural gas producing state in the US.

Metamorphic rocks get their name from "meta" (change) and "morph" (form). These rocks are made up of igneous and sedimentary rocks of all ages which have been exposed to intense pressure and heat, usually under the surface of the earth. The rocks that result from these processes often have ribbon-like layers and may have shiny crystals, formed by minerals slowly growing on their surface over time. Even though heat is involved, they didn't start off as molten rock. However, you can often find metamorphic rock near volcanoes and sources of super-hot



rock. Geologists classify metamorphic rocks according to how much they have been changed from the original, or parent, rock.

The rocks of Earth's crust are constantly being recycled and changed into new forms through geologic processes. This continual transformation of rocks from one type to another is called the rock cycle. Through processes such as weathering, heating, melting, cooling, and compaction, any one rock type can be changed into a different rock type as its chemical composition and physical characteristics change.

In Arkansas, we drill for oil and natural gas and have for many decades. Shale in southern Arkansas is rich in oil, some of which they have been able to extract through vertical drilling – that is drilling one straight, vertical hole and pulling from the shale at the point where the hole was drilled. Vertical drilling is also used to extract natural gas in Arkansas' Arkoma Basin, which is located in northwestern Arkansas in Crawford and Sebastian Counties.

A newer, more technologically advanced method is called horizontal drilling. This method drills a vertical hole, then has a special drill bit that is able to do a ninety degree turn and then drill further in a horizontal line. After this path is drilled, a process called hydraulic fracturing takes place. In this process, the drill bit is removed and another tool places small charges at certain segments in the path. These charges are then set off and create cracks in the surrounding shale. A plug is placed after each charge to hold the natural gas in until all fracturing has concluded. At that point, the plugs are all removed and fracturing fluid is forced at a very high rate of speed into the path. Fracturing fluid is composed of 99.5% water and sand and .5% chemicals. The chemicals, most of which are used in our homes to clean and on our bodies to clean and lubricate our skin, help in the fracturing process to clean out the drilling path and grease the path for the sand that will stay inside of the cracks in the shale to hold it open so it can release its gas into the pipeline.

Advances in horizontal fracturing over the past ten years have created what is called the "Shale Revolution" in the United States and beyond. We are now able to drill and extract both oil and natural gas from places that were thought unrecoverable previously. Therefore we are now producing more oil and natural gas in the United States than ever before in history. Horizontal drilling is preferred when possible because it creates fewer holes and disturbances to the land and a much larger volume of oil and gas can be extracted from the shale through this process. An easy metaphor would be in trying to extract icing from the middle layer of a cake. If you take a straw and poke a hole down to the icing layer, you can get some of the icing. But if you take a bendable straw and poke it down to that layer, then turn it horizontally, you can pull a great deal more icing out – a much "sweeter" way of attaining your goal!

Student Activity:

Day 1: Categories of Rocks



1. Before class begins, place several sets of rock samples around the room. Each set should have an example of sedimentary, metamorphic and igneous rocks.
2. Distribute Student Handout: *Lesson 1: Categories of Rocks* (See Student Handout section and the printable file from the web site.) and go over the instructions with students. Show students the sets of rock samples and explain the rules for use.
3. Allow time for students to research the categories of rocks and complete question 1 on the handout.
4. As students finish the first question, have them choose a partner and complete question 2 on their handout.
5. When the pair completes question 2, they may move to a set of rocks and complete question 3.
6. Collect handouts to be used for background on Day 2.

Day 2: Teach About Rocks

1. Distribute Student Handouts *Lesson 2: Teach About Rocks*
2. Organize students into groups of five. Have the groups select one type of rock to research. Using the information gained from *Lesson 1: Categories of Rocks* and other classroom resources, have students design a brochure about the rock type. The brochure must include a drawing of the rock and must include the following information:
 - what it is made of
 - where it is found (any in Arkansas)
 - what it is used for
 - how it is formed.
3. Using the computer, their textbook, an iPad or other classroom resources, each student should write about one of the four topics listed in their handout. One member of the group will make a drawing of the rock.
4. Explain that each group will use their information to teach the class about their rock and will display their brochure in the classroom.
5. Use a rubric to assess the students as they make their presentations. Good examples can be found in the following web sites, or you may search the internet for suitable examples.
http://www.readwritethink.org/files/resources/lesson_images/lesson416/OralRubric.pdf
<http://ed.fnal.gov/lincon/w01/projects/library/rubrics/presrubric.htm>

Day 3: Sedimentary Rocks

1. Before class begins, assemble all materials for preparing the model of the sedimentary rock: These are listed in the materials list at the beginning of the unit, in the students' handout, *Lesson 3 Sedimentary Rocks*, or on the following web site:
<http://www.pages.drexel.edu/~ks73/Ediblerocks.htm>
2. Label each ingredient with what it represents.



WHITE SAND: White Bread

The river washes small pieces off the surrounding rocks. These pieces of sand are carried along by the water and left on the bottom of the river.

MUD AND ROCKS: Peanut Butter

A flood washes mud and rocks into the river.

CLAY: Brown Bread

The river is dammed so that the water barely moves. The water no longer has the power to carry the rocks and dirt so these all fall to the bottom of the river making a layer of clay.

PLANT PARTS: Red Jam

As the plants along the river's edge die, their remains fall into the river and settle at the bottom.

ANIMAL BONES: Purple Jam

There are many kinds of creatures living in and around the river. When they die, their bones fall to the bottom of the river.

DUST: Graham Cracker Crumbs

There is a drought so the area is dusty and dry. Strong winds pick up bits of dust from nearby mountainside. These fall in the river.

ROCKS: Raisins

A part of the riverbank falls into the river, dumping lots of rocks on the bottom.

FOSSILS: Animal shaped cracker or candy

A large animal died and fell to the bottom of the river. Conditions were such that the carcass was immediately covered with clay and the animal was preserved as a fossil.

3. Since students will be allowed to eat the sandwich, be sure to provide sanitary conditions for preparing their "experiment."
4. To prepare students for today's lesson, show a video from the internet that explains how sedimentary rocks are formed. The Geology Kitchen video shown in the list below is excellent. <http://www.youtube.com/watch?v=eOuPsJwYu9I> (**Geology Kitchen Series**)
5. Distribute the Student Handout: *Lesson 3: Sedimentary Rocks* and an example of a sedimentary rock containing a fossil for each table group. Go over the background information with the students. Have students underline important facts. Students will refer to the rock sample as they review the background information.
6. Explain that the students will make a model of a sedimentary rock with the ingredients around the room, and then write a story about how their "rock" was formed according to how they layered their ingredients.



Helpful Hints

- Check for food allergies. You can substitute cream cheese with fruit bits for the peanut butter if you have students with peanut allergies.
- To make your own graham cracker crumbs put whole graham crackers in a sealed bag and roll with a rolling pin or hit with a hammer.
- To simulate a fossil, gummy bears, gummy worms, chocolate teddy grahams or other soft animal shaped foods can be added to the sandwich.
- Stress that students use disposable gloves and practice sanitary handling so they may eat the sandwich when finished.
- Move around the room and ask questions about what is happening in each addition of ingredients to their sandwich. Check for understanding of the process
- Ask for volunteers to read the story of their “rock.”
- Question students about what they did and how it relates to the actual formation of sedimentary rocks.
- Collect stories to check students grasp of sedimentary rock formation.

Day 4: Drilling for Oil and Natural Gas

1. Before class begins, arrange the materials for the “drilling activity” on a classroom table. (See Student Handout for a list of materials) Cover the materials so that students do not see the “tools” and the “land mass” (cupcakes)
2. Prepare a certificate or some other award for the winner(s) of the engineering challenge. These can be displayed in the classroom after the activity.
3. Go over the background information about oil and natural gas production included in the *Teaching Notes* section at the beginning of the unit.
4. Distribute Student Handout: *Lesson 4: Drilling for Oil and Natural Gas* and have students read the introduction and questions.
5. Depending on how much time you have planned for the activity, you may show selected videos or all that are listed in the materials list at the beginning of the unit. (You **MUST** show at least one that has both oil and gas drilling or one of each process so students know what is being simulated.)
6. Allow time for students to work in pairs to answer the questions on the student handout.
7. Read the Activity section of the student handout with the students and answer any questions they have about how to proceed with the drilling model.
8. Reveal the materials they can use and ask one person from each table to get a cream filled cupcake for each person at their table. (See materials list)
9. Give students time to plan and carry out their engineering design for “drilling” for “sweet



energy” (cream filling in cupcake).

10. After all results are recorded on the class chart, determine the winning design(s) and award certificates to the winning team(s). Allow students to enjoy their land mass and sweet energy sample.
11. For students who finish early or to extend the lesson, allow students to play the virtual oil well game: www.learntodrill.com/drilling-games or search the internet for a game using key phrase: oil drilling game.

Day 5: Ask an Expert

1. Invite an expert or panel of experts who are knowledgeable about oil and natural gas resources in Arkansas to come to your class to speak. Multiple speakers can be found through the Arkansas Energy Rocks website (www.arkansasenergyrocks.com), Arkansas Oil & Gas Commission (www.aogc.state.ar.us), Arkansas Geological Survey (www.geology.arkansas.gov/), Arkansas Division of Environmental Quality (www.adeq.state.ar.us/) or AIPRO, the organization representing the oil and natural gas industry (www.aipro.org).
2. Another option is to ask your students if they have a parent or grandparent working in the oil and natural gas industry in Arkansas who would be willing to speak to your class. If you cannot find a speaker to come to your class there are many videos online to introduce the lesson and facilitate a discussion with the students. Also, you could email questions to USGS and other organizations that have experts who answer online requests for information. The websites below can guide you in your delivery of this fifth lesson.
 - Ask a Geologist - <https://answers.usgs.gov/>
 - National Energy Education Development Project: NEED - <http://www.need.org>
3. Have students prepare questions for the speakers about the topics covered in the unit and others they would like answered. Also, this would be a great opportunity to have your students teach the speaker something new they learned from this unit using the brochure they created or the design plan they invented for drilling.
4. Students will take notes on the speaker(s) and write a report to summarize what they learned. Ask volunteers to share one interesting thing they learned from the speaker.
5. Collect the reports and post them in the classroom.

Student Handouts: See web site for a printable copy:

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



Student Handout 1

Digging Into Energy from Arkansas Rocks

A Unit for Discovery

LESSON 1: Categories of Rocks

1. Using a textbook, classroom resources, an iPad, or a computer for an internet search, find information to complete the following chart about the three categories of rocks:

Categories of Rocks	IGNEOUS	METAMORPHIC	SEDIMENTARY
What are they made of?			
How are they made?			
Where can they be found?			
What are they used for?			

2. Once the chart is complete, partner with a classmate and discuss how your charts are alike and how they are different.

Write down one **difference** between the information in your chart and your partner's chart:

Write down one **similarity** between the information in your chart and your partner's chart:



3. Look at the rock samples the teacher has placed in the classroom. They are labeled as igneous, metamorphic, and sedimentary. Describe how each type of rock looks to you in the space below.

Igneous	Metamorphic	Sedimentary



Student Handout 2

Digging Into Energy from Arkansas Rocks A Unit for Discovery Lesson 2: Teach About Rocks

Group Members:

1. _____
2. _____
3. _____
4. _____
5. _____

Working in a group of five, choose one type of rock to research. Using the information chart you created in Lesson 1: Categories of Rocks and other classroom resources you will create a brochure about your rock type and develop a plan to teach the class about you rock category. Your brochure will be designed to fit one sheet of construction paper, front and back. Your presentation will be no more than 10 minutes.

What rock type is your group teaching about? _____

Your brochure and group teach must include a drawing of your rock and the following topics. Decide who will complete each of these and label the topics below:

What it is made of? _____

Where it is found? _____

What it is used for? _____

How it is formed? _____

Who is drawing the example rock? _____

As a group, decide on a design for your brochure and a plan for your presentation then use your textbook, classroom materials, library resources or an iPad or a computer to conduct an internet search to write your part of the brochure and group teach.

Once you have all finished your part, work together to design your brochure. Practice your presentation and be prepared to present to the class. Your group's brochure will also be displayed in the classroom.



Student Handout 3

Digging Into Energy from Arkansas Rocks A Unit for Discovery Lesson 3: Sedimentary Rocks

Focusing on Sedimentary Rocks:

Sedimentary rocks are formed by larger rocks or particles breaking down into smaller pieces called sediments. The larger rocks are broken by many processes such as weathering or erosion by wind or water. Those smaller pieces, called sediments, then get deposited or dropped off at a new place after being carried by water, wind or other methods of transportation. One layer of sediment gets deposited on another, then another. The weight of each layer presses the next layer together with great force ultimately forming a new rock from old sediments. Examples of sediments are pebbles, grains of sand, plant and animal remains, silt and clay.

Some sedimentary rocks contain fossils. Fossils are the remains or imprints of once living organisms. These remains often get trapped in sediment and as layers of sediment form atop one another a fossil is embedded in the rock. Look at the sample sedimentary rocks at your table that contain fossils. Discuss within your group how you think those fossils were formed.

Shale is the most abundant type of sedimentary rock and is found worldwide. In Arkansas, we have two areas of shale where natural gas is found - the Arkoma Basin in western Arkansas and eastern Oklahoma and in The Fayetteville Shale which covers ten counties from western to eastern Arkansas. Millions of dollars of natural gas is produced in Arkansas every day. In fact, Arkansas now ranks as the 8th leading natural gas producing state in the US.

Activity:

We are going to make our own edible sedimentary rock model called shale in class today.

Sedimentary Sandwiches

(15 minutes)

Adapted from: <http://www.pages.drexel.edu/~ks73/Ediblerocks.htm>

Materials:

Loaf of white bread

Loaf of brown bread

Graham cracker crumbs

Red jam

Purple jam

Raisins

Crunchy peanut butter (Modify if you have students with peanut allergies.)

Animal shaped crackers or candy (optional)

Plastic knives—one per student

Paper plates—one per student



What to Do:

1. Sedimentary rocks are formed when layers of sand, small bits of rock, clay, plants, bones, and mud are piled on top of each other and eventually get compressed and harden into rock. Sedimentary rocks are often formed in river bottoms and lakes since the water carries materials from other places that then settle to the bottom in layers. This process takes a long time (hundreds of thousands of years). You will see a model of this process when you make your Sedimentary Sandwich.
2. Use a paper plate to represent the bottom of a river.
3. Before you begin to build your model, examine the various materials you can use as layers in your sedimentary rocks: white bread for white sand, brown bread for dust, peanut butter for mud, raisins for big rocks, red jam for old decaying plants, purple jam for old bones and remains of animals, and graham cracker crumbs for clay.
4. Make your own sedimentary sandwich using the ingredients in any order you choose, thinking with each addition, what each layer represents. *(If your teacher includes the fossil in the activity, be sure to tell how the plant or animal got into the layers.)*
5. These layers get compressed, or smashed together, over time to become rock. Press down on your sandwich to represent the compression of the layers. You may want to cover your model and use a book for even pressure.
6. After you have made your sandwich, write a story explaining what events took place in your sedimentary rock's formation. Use the descriptions that accompany the list of ingredients at the end of this worksheet to plan your story.
7. Look at each other's sandwiches and notice the variations in layers.
8. What will happen if an earthquake occurs or a mountain is formed by a shift in a geological plate? Illustrate that by bending or breaking your sandwich. What happens to the layers? Look at other students' "rocks" to see what happened with different layers when they simulated an earthquake or plate shift. How is this like a real earthquake or shift in geologic plates?
9. Be prepared to share the story of your rock's formation and answer questions about your rock.



Use the following to help you tell the story of your rock:

WHITE SAND: White Bread

The river washes small pieces off the surrounding rocks. These pieces of sand are carried along by the water and left on the bottom of the river.

MUD AND ROCKS: Peanut Butter

A flood washes mud and rocks into the river.

CLAY: Brown Bread

The river is dammed so that the water barely moves. The water no longer has the power to carry the rocks and dirt so these all fall to the bottom of the river making a layer of clay.

PLANT PARTS: Red Jam

As the plants along the river's edge die, their remains fall into the river and settle at the bottom.

ANIMAL BONES: Purple Jam

There are many kinds of creatures living in and around the river. When they die, their bones fall to the bottom of the river.

DUST: Graham Cracker Crumbs

There is a drought so the area is dusty and dry. Strong winds pick up bits of dust from nearby mountainside. These fall in the river.

ROCKS: Raisins

A part of the riverbank falls into the river, dumping lots of rocks on the bottom of the river.

(Optional:

FOSSILS: Animal shaped cracker or candy

A large animal died and fell to the bottom of the river. Conditions were such that the carcass was immediately covered with clay and the animal was preserved as a fossil.



Student Handout 4

Digging Into Energy from Arkansas Rocks A Unit for Discovery Lesson 4: Drilling for Oil and Natural Gas

Energy trapped in rocks can be in a gas form like natural gas or in a liquid form like oil. In Arkansas, we have rocks that produce both natural gas and oil in various regions of the state.

Your teacher will show you one or more of the following videos in class to see what happens in the drilling processes used to extract this energy resource. You may research others if you need more information.

Search the internet for a video using the key words shale drilling; oil drilling; or use oil and gas drilling with newest technology; and hydraulic fracturing. Some examples are included below:

Video of shale drilling: the video below:

- <https://www.youtube.com/watch?v=vKuTWSn3nKA>

Video of oil drilling:

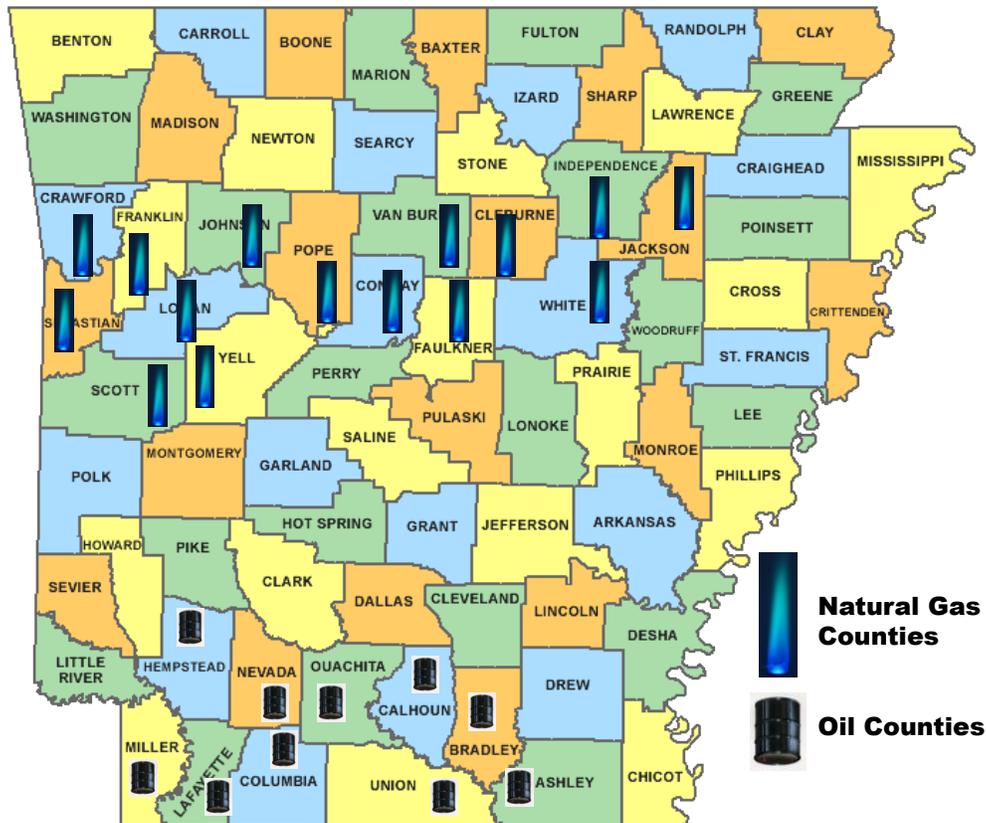
- www.neok12.com/Natural-Resources.htm (Scroll down to watch videos and click on offshore drilling 2:50, and then watch extreme oil drilling 3:00.)
- https://www.youtube.com/watch?v=SfazJ6P_g7w
- <https://www.youtube.com/watch?v=5Sam5HKOzbw>
- <http://videos.loga.la/horizontal-drilling-animation>

Video of oil and gas drilling using newest technology—hydraulic fracturing

- <https://www.youtube.com/watch?v=WTZimJK09IA>



The map below shows where oil and natural gas are found in Arkansas.



Working with a shoulder or face partner, answer the following questions.

1. How do we get the energy that is trapped inside rocks out and into a usable form?
2. What is one difference between natural gas drilling and oil drilling?
3. If you could ask an expert anything about **natural gas drilling**, what would it be?

Why?



4. If you could ask an expert anything about **oil drilling**, what would your question be?

Why?

5. What is one everyday thing natural gas is used for?

6. What is one everyday thing oil is used for?

7. Why do we need oil and natural gas as energy sources for our everyday lives?



Activity: You be the expert—Drilling for Sweet Energy.

You will receive a land mass filled with sweet energy. Working with a partner, you must design a method to remove the **most sweet energy** from your landmass with the **least damage to the land mass**, using only the tools provided at the table at the front of the room (popsicle sticks, plastic spoons, plastic knives, plastic forks, regular straws, bendable straws, coffee stirrer straws, toothpicks, string, small paper cups,). You must also keep your sweet energy source to see whose design actually removes the most “sweet energy.”

You must have an **illustration and a written plan** of your engineering design before you attempt to carry out the plan. Make sure you write down all needed materials to conduct this drilling and removal plan. You must show your plan to your teacher and have it approved before you begin – once approval is granted – begin the process of drilling.

To see who wins this engineering design challenge, you will first measure the amount of sweet energy retrieved using the classroom scale. To determine the amount of damage done to the land mass, have the teacher examine the “energy sample” and “land mass” and rank it 0-10 with 0 being no damage and 10 being extensive damage. Record your weight and damage assessment on the chart provided by the teacher. Once all measurements have been made and recorded the winning engineering design will be announced.

You may now eat your land mass and sweet energy sample!



Engineering Design Challenge – Sweet Energy Drilling Design Plan

Illustration of Plan:

Written Plan:

Amount of sweet energy retrieved: (Measure by using scale in classroom – place cup with energy source on scale and record the value.)

Is your energy source clean? Only pure sweet energy (white filling) no crumbs or rock debris in your sample). Your rank?

EXTENSION: Game for oil drilling

<https://www.learntodrill.com/drilling-games> --There are several oil drilling games on the internet that allow you to simulate the drilling process. This site reviews seven games and allows download.

Or conduct an internet search using the key words: oil drilling game.



Student Handout 5

Digging Into Energy from Arkansas Rocks

A Unit for Discovery

Lesson 5: Ask an Expert

Guest Speaker Report Format

1. Questions I will ask the speaker:

(Pay close attention to the speaker! DO NOT ask a question if the speaker has already given that information.)

2. Take notes on any topics that apply to this speaker:

- Speaker's name, title, place of employment/service.
- Education and training necessary for their position.
- What is the nature of the work they do?
- How does this fit in with the larger scope of services provided by their company or agency?
- Describe the people they serve/help.
- What were the main things they wanted you to know about the program they represent?
 - Provide some detailed examples
 - What was most interesting to you and why?
- How can you use this information now or in the future? Provide specific examples

3. Use your notes to write a report on a separate sheet of paper about this speaker.

4. Share with the class one interesting thing you learned from the speaker.