Title: Oil and Natural Gas in Arkansas – Lesson 2: Sedimentary Rocks	
Course: Science, Language Arts, Library Media **Grades**: 5-8	**Duration**: 3 Class Periods (3 hours)

Standards: Arkansas State Frameworks

Subject	Grade Level(s)	Code	Standard
Science	5	5-PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]
		5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; or the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]
	6	6-ESS2-4	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle.

			Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]
	7	7-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [AR Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Arkansas specific examples of geologic materials include Karst, bauxite, and diamonds.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]
		7-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]
Language Arts	5	RI.5.2	Examine a grade-appropriate informational text.

			● 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. ● 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 • 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 Level: Analyzing, Applying, 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.			

Teaching Notes:

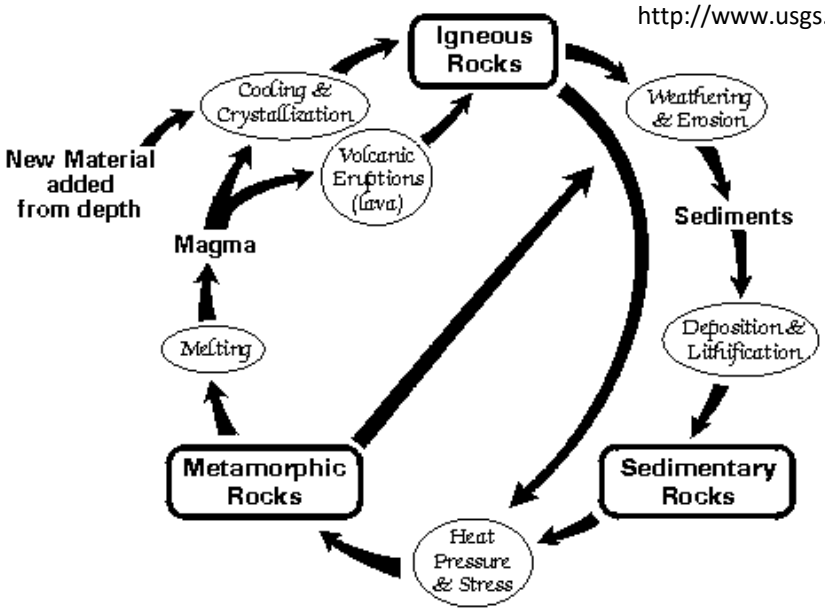
Fossil fuels, like oil and natural gas, are intimately associated with what are known as sedimentary rocks. Because sedimentary rocks originate from processes that occur at the Earth's surface, these are the rocks that ultimately incorporate the organic material necessary for the formation of fossil fuels. Earth is a terrestrial planet, meaning that its outer layer is solid. Scientists refer to this layer as the lithosphere because it is composed of rocks. Rocks are defined simply as solid mixtures of minerals. Our planet has an incredible variety of rocks for two basic reasons—1) our planet's interior has not completely cooled, and 2) our planet has an atmosphere that contains water vapor. The processes that occur because of these characteristics work to produce the myriad rocks that make up the Earth's lithosphere.

The Rock Cycle

Rocks in the Earth's lithosphere are classified according to three categories which are based on how they formed—igneous, metamorphic, and sedimentary. Igneous rocks are products of the Earth's hot interior and are formed by the cooling of liquid rock called magma. Metamorphic rocks form from preexisting rocks that have been modified by heat and/or pressure. Sedimentary rocks form from the fragments of preexisting rocks as well as by chemical and biological activity at or near the Earth's surface. Our Earth is a dynamic planet, meaning that it is constantly undergoing change. Consequently, any type of rock can be transformed into any other type of rock—this is called the rock cycle.

The Rock Cycle

http://www.usgs.gov/visitors/rocks_quiz.asp



Our focus in this lesson, however, is sedimentary rocks. Let's look in more detail at the formation of sedimentary rocks.

Weathering

Forming sedimentary rocks begins with processes that occur at the surface of the Earth. Preexisting rocks brought to the Earth's surface by geologic processes are subjected to the atmosphere. Gases and water cause chemical and physical changes to occur—this is collectively referred to as weathering. Weathering creates the particles and dissolved chemicals that eventually become sedimentary rocks.

Transport and Deposition (Sedimentation)

Once the particles and chemicals are formed they are next transported and deposited. Water is the primary medium of sediment transport, but wind can also play a role. Sediments will move as long as the energy of the moving medium is sufficient to push or carry them. When the energy is no longer sufficient, the sediments stop moving and settle. This is called deposition.

Burial, Compaction, and Cementation

After the sediments are deposited they undergo a sequence of burial, compaction, and cementation. Burial is caused by the build-up of sediment in one spot over a period of time. As the sediment is buried deeper and deeper, pressure from the weight of the overlying sediment causes compaction. Compaction results in the expulsion of water and the squeezing together of the sediments. Finally, the sediments become cemented together forming solid rock.

Student Handouts:

- Student Handout 1 Lab 1—Sedimentation
- Student Handout 2 Lab 2—Making Sedimentary rocks
- Student Handout 3 Lab 3—Types of Sedimentary Rocks

Pre-assessment Questions:

1. What are rocks?
2. How many different types of rocks are there?
3. What are sedimentary rocks?
4. How do sedimentary rocks form?

Background Information:

Suggested videos and animations that can serve as introductory information about sedimentary rocks and how they form. 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

Introduction to Sedimentary Rocks
https://www.youtube.com/watch?v=U8Y3oaYR-3c

Animated Rock Cycle
http://www.phschool.com/atschool/phsciexp/active_art/rock_cycle/

Interactive Animated Rock Cycle
http://www.classzone.com/books/earth_science/terc/content/investigations/es0602/es0602page02.cfm

What are Sedimentary Rocks?
http://geology.com/rocks/sedimentary-rocks.shtml
https://www.sciencedaily.com/terms/sedimentary_rock.htm

Sedimentary Rocks
http://studyjams.scholastic.com/studyjams/jams/science/rocks-minerals-landforms/sedimentary-rocks.htm

Formation of Sedimentary Rock Layers
http://www.youtube.com/watch?v=Yf4YtDlA1oQ

Discovery Education also has several videos and video segments about sedimentary rocks.

Student Handouts: See web site for a printable copy:
http://www.arkansasenergyrocks.com/educators/lesson-plans-k-8/

Student Handout 1

Lesson 2—Oil and Natural Gas: Sedimentary Rocks
Lab 1—Sedimentation

Introduction

Now that you have been introduced to the concept of sedimentary rocks and how they form, you will observe the process of deposition. Deposition is the settling to the bottom of sediments in a fluid. Deposition is a crucial step in the formation of sedimentary rocks. Look at the picture of the rock on the right. This is a rock geologists' call "conglomerate". How do you think it formed?

Materials

- Glass jar with lid
- Gravel
- Play sand
- Water

Procedure

1. Fill the glass jar 1/3 full with a mixture of sand and gravel.
2. Add water until the jar is about half full.
3. Put the lid tightly on the jar.
4. Make a hypothesis for this question: What will happen to the contents of the jar if it is shaken, then allowed to sit for 5 minutes?

   Hypothesis:

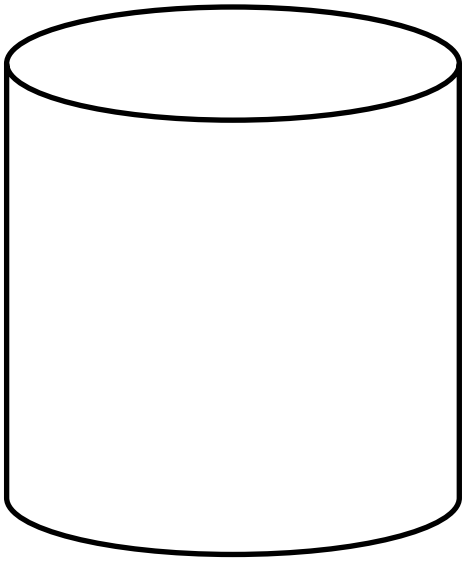
   _____

   _____

5. Shake the jar for 30 seconds.
6. Set the jar on your desk in front of you and observe what is happening to the sand and gravel.
7. Let the jar sit still for 5 minutes.
8. Make a drawing of the jar and its contents in the results section.

Results

Make a drawing of your jar and label it.



Analysis and Conclusions

1. Was your hypothesis proved or disproved? Explain your answer.

   _____

   _____

2. What force causes the sediments to settle to the bottom of the jar?

   _____

   _____

3. Which of the layers in your jar looks most like the picture of the rock on the front of the lab handout?

   _____

   _____

4. How many layers of material formed in the jar?

5. Describe the differences between each layer.

6. Explain why the materials in the jar formed layers in the order that they did.

7. Why is the water cloudy after you shake it?

8. Do you think the water will become clear over time? Why?

Student Handout 2

Lesson 2—Oil and Natural Gas: Sedimentary Rocks
Lab 2—Making Sedimentary Rocks

Introduction

In the previous lab you demonstrated the concept of deposition. In this lab you will simulate the final process in the formation of a sedimentary rock—cementation. The rock pictured on the right is called sandstone. Is this an apt name for this rock? Why? How do you think the particles came to be "stuck" together?

Materials

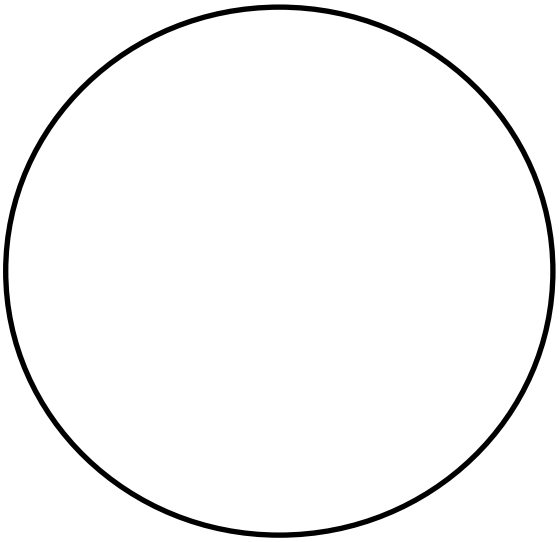
- Wax paper
- Magnifying glass
- Water
- Sugar
- Sand
- Spoon
- 2 Paper cups

Procedure

1. Pour a spoonful of sand into a paper cup.
2. Fill another cup with a teaspoon of water. Stir in 5 spoonfuls of sugar until it is dissolved.
3. Pour the sugar water mixture slowly into the cup of sand until it is moistened. Pour off any excess water.
4. Let the "rock" dry then carefully tear the paper cup off over a piece of wax paper.
5. Let the "rock" sit and harden for at least 2 days.
6. Use a magnifying glass to observe your "rock." Draw an illustration of what you see.

Results

In the circle below make a close-up drawing of your rock and label it. Note in your drawing the sand grains and the cement that is holding the grain together.



Analysis and Conclusions

1. What is the “cement” that is holding the grains of sand together in your rock?

2. What happened to the water that was in the cup?

3. Explain the process that turned the loose sand into a rock called sandstone.

Student Handout 3

Lesson 2—Oil and Natural Gas: Sedimentary Rocks
Lab 3—Sedimentary Rocks

Introduction

In the two previous labs you investigated two of the processes involved in forming sedimentary rocks—deposition and cementation. Now you will have the opportunity to observe some of the types of sedimentary rocks and their characteristics. Classifying sedimentary rocks is based on how they formed. There are three categories—1)clastic, 2)chemical, and 3)organic. Clastic sedimentary rocks form from the solid particles of other rocks. Chemical sedimentary rocks form primarily from the evaporation of seawater. Organic sedimentary rocks form from the remains of living organisms.

Materials

- Collection of different types of sedimentary rocks*
- Magnifying Glass
- Dilute HCl acid
- Paper towel.
- Rock and Mineral book (see references)

Procedure

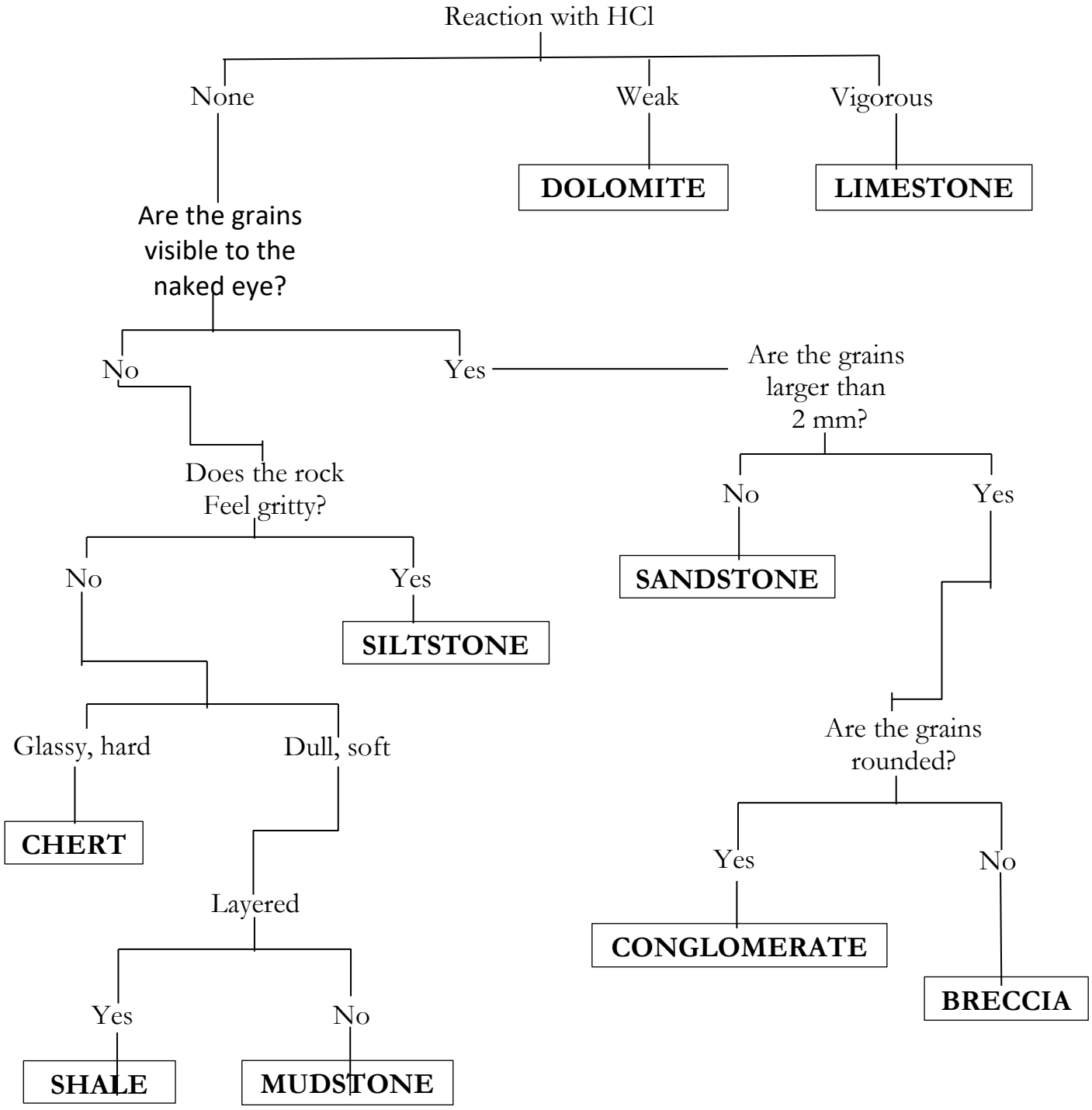
1. Take the rocks out of their box/container and place them on your table.
2. Record their number in the data table.
3. Write a brief description, noting color, texture, hardness, and fossils.
4. Place a drop of dilute HCl on each rock and note its reaction in terms of NONE, WEAK, or VIGOROUS.
5. Use a paper towel to dry off any excess acid.
6. Use the flow-chart on page 27 to identify the rocks.
7. Use the rock reference book to determine which category it belongs to.

Results

Fill out the following data table.

Category										
Name										
Reaction With HCl										
Description										
Rock Name										

Sedimentary Rock Identification Flow-Chart



References

Bell, Pat and Wright, David. Rocks and Minerals. Macmillan Field Guides. New York, New York. Collier Books. 1985.

Chesterman, Charles W. Field Guide to North American Rocks and Minerals. The Audubon Society. New York, New York. Alfred A Knopf. 1978.

Mottana, Annibale et al. Guide to Rocks and Minerals. New York, New York. Simon & Schuster. 1978.

Pough, Frederick H. Rocks and Minerals. Peterson Field Guides. New York, New York. Houghton Mifflin. 1996.