TEACHER GUIDE
to
OKLAHOMA LANDFORMS
and
OKLAHOMA ROCKS

PASS for Grade 8 Earth/Space Science

Standard 4.1 Landforms result from constructive forces such as crustal deformation, volcanic eruption, and deposition of sediment and destructive forces such as weathering and erosion.

Standard 4.2 The formation, weathering, sedimentation and reformation of rock constitute a continuing "rock cycle" in which the total amount of material stays the same as its form changes.

OKLAHOMA LANDFORMS DVD

Text for the Bellringer

As you view these images of places in Oklahoma, write down on a piece of paper how you think each one of these places was formed. These images will all be shown two times.

For example, were the mountains formed by volcanoes or by layers of rock that were once pushed upward?

What shaped Oklahoma's mesas, buttes, and canyons? Was it from erosion caused by glaciers, or the wind, or from flowing water?

For each landform, write down the types of erosion that continue to change their size and appearance.

Listing of Images: Arbuckle, Ouachita, and Wichita Mountains, Black Mesa, Alabaster Caverns State Park, Red Rock Canyon State Park, Little Sahara State Park, Great Salt Plains (State Park and National Wildlife Refuge), Gloss Mountains State Park

OKLAHOMA ROCKS DVD

Text for the Bellringer

As you view these rock formations, write down the kind of rocks that you are seeing.
Which ones are igneous rocks?
Which ones are sedimentary rocks?
Which ones are metamorphic rocks?

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Series of images of landforms and close-up images of rocks within Oklahoma.

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All of these rock formations are within Oklahoma. Can you identify which region in Oklahoma each of these places is found?

For example, is the picture of a place in western Oklahoma, or southern Oklahoma? Write your answer for each picture.

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Oklahoma Rocks - Background Information

Definitions

Minerals A mineral is a substance that has four characteristics:

1) is a solid
2) has a definite chemical composition
3) has a crystal structure
4) is formed by natural processes

Rocks Rocks have two characteristics:

1) is a solid
2) is formed by natural processes

A rock normally contains two or more types of minerals.

Igneous Rock The word **igneous** means "of fire" or "born of fire." Intense heat from deep within the earth is able to melt rock, turning it into magma. Lava is magma that reaches the earth's surface.

Igneous rocks are formed when molten rock cools and becomes solid. Granite is an igneous rock that was formed within the earth as magma slowly cooled. Granite is an intrusive igneous rock.

Basalt is an igneous rock that formed from lava that quickly cooled while on the earth's surface. Basalt is an example of an extrusive igneous rock.

Places to see igneous rocks in Oklahoma:
Granite and rhyolite are igneous rocks that can be seen in the **Wichita Mountains** of southwest Oklahoma (Wichita Mountains National Wildlife Refuge).

North and northwest of the community of **Tishomingo** are granite rocks that are believed to be over one billion years old. These are the oldest rocks that can be observed in our state.

Basalt caps the top of **Black Mesa** at the northwest tip of the Oklahoma Panhandle (near Black Mesa State Park).

Sedimentary Rock: Sediments consist of minerals, particles of rocks, and sometimes pieces of organic material. Sediments can be carried by air and water. Sediments may accumulate or settle on land or underwater (such as at the bottom of a river, lake, or ocean). Sedimentary rock is formed as layers of sediments are deposited on top of each other. The top layers of sediment apply pressure to the buried sediments. In some cases, particles of sediment are bound, or cemented, together by minerals that have crystallized between them. With time, the sediments become layers of sedimentary rock.

In Oklahoma, nearly 99% of the rocks that can be seen at, or near, the earth's surface are sedimentary rocks.

Sandstone is a type of sedimentary rock that forms when grains of sand are combined together. **Shale** is a sedimentary rock that consists of fine-grains of silt or clay. Because shale is a softer rock than most types of sandstone, it erodes more easily than sandstone.

Limestone is another type of sedimentary rock that is present in many locations within Oklahoma. Limestone consists of calcite and carbonate minerals. Ocean organisms, such as clams, oysters, and tiny coral organisms, use these minerals to make their shells or skeletons. As these aquatic plants and animals die, their shells and skeletons sink to the bottom of the ocean. In prehistoric oceans, thick layers of these shells and skeletons accumulated as carbonate mineral-sediments on the ocean floor. With pressure and time, these sediments were cemented together, making limestone rock.

Gypsum and dolomite rocks are frequently seen in western Oklahoma. While sedimentary, these rocks are also called "evaporite" rocks. During the Permian Geologic Period (approximately 270 to 220 million years ago), much of western Oklahoma was periodically covered by shallow seas. At times the concentration of dissolved solids in the sea water became so great that these minerals precipitated onto the bottom of the sea. The normal sequence for this evaporite precipitation was first a thin layer of dolomite, then a thick layer of gypsum, and finally a thick layer of salt.

Gypsum is a moderately soluble rock, meaning that it can dissolve in water. In the semi-arid climate of western Oklahoma, gypsum generally resists erosion, and for this reason it is the caprock on top of many bluffs and buttes. However, as is evidenced in Alabaster Caverns and other western Oklahoma locations, ground water can gradually dissolve gypsum, forming sinkholes and vast networks of caves. Alabaster is a type of gypsum that has a smooth texture, and consists of compact, fine grains of this mineral. Selenite is another kind of gypsum. Selenite is made up of transparent or translucent crystals.

Many of the rocks that were formed during the Permian Period are red in color. When these muds and sands were deposited as sediments, they had already been stained with a thin coating of oxidized iron minerals (primarily hematite). This red color is persistent. The soils that have developed from these Permian rocks retain the original red color.

Places to see sedimentary rocks in Oklahoma:
The **Arbuckle Mountains of southern Oklahoma** are an excellent place to see many kinds of sedimentary rocks.

For example, as one travels through the Arbuckle Mountains, **southbound on Interstate 35, just south of the scenic turnout,** one can observe exposed layers, or strata, of limestone and dolomitic limestone rocks that have a tombstone appearance. Part of the Kindblade Formation, these tilted rocks are called a "tombstone topography."

Likewise, as one travels **northbound on Interstate 35, in and around the scenic turnout**, you can observe more examples of "tombstone topography" as well as layers of limestone rocks that have been dramatically folded. Where the folded rock is arched upward, it is called an anticline; where the rock strata bends downward, it is called a syncline.

In southeast Oklahoma, the Ouachita Mountains are also a good place to see sedimentary rocks, including shale, sandstone, and limestone.

In northeast Oklahoma, the Ozark Plateau features limestone, sandstone, and shale. The bluffs that border the **Illinois River**, near Tahlequah, feature these rocks. **Natural Falls State Park**, near West Siloam Springs, is also a good place to view some of the rock strata of the Ozark Plateau.

Near Hinton, in western Oklahoma, is Red Rock Canyon State Park. The red sandstone walls of this canyon were formed as sedimentary rock during the Permian Period. The canyon was formed as water flowed across this sandstone. This process of water erosion likely began during one of the Ice Ages of the Pleistocene Geologic Period.

Alabaster Caverns State Park, in northwest Oklahoma, offers an excellent place to examine the effects of water erosion on gypsum rock.

Metamorphic Rock: Rocks that change from one type of rock to another kind of rock are called metamorphic rocks. The original sedimentary or igneous rock is called the parent rock. Heat, pressure, and sometimes chemically active fluids and gases can cause parent rocks to become metamorphic rocks. A metamorphic rock can be a parent rock for another kind of metamorphic rock.

Places to see metamorphic rock in Oklahoma:
While metamorphic rock is not common on the surface of Oklahoma's landscape, there are a few locations where it can be seen. Metamorphic rock is at the earth's surface in a couple of places at the **eastern edge of the Arbuckle Mountains**, north of Tishomingo.

A small band of metamorphic rock is also located in the **Wichita Mountains, north of Mount Scott**.

One of the best places to observe metamorphic rock in Oklahoma is at, or near to, **Beavers Bend State Park, in southeast Oklahoma**. Slate is present within the rock formations that are exposed below the emergency spillway of Broken Bow Lake, as well as on the east side of U.S. Highway 259, two and one-half miles north of the south entrance to Beavers Bend State Park.

A third location is about twelve miles west of Broken Bow, on the south side of State Highway 3, immediately **west of the Glover River**. Here the shale is actually a phyllite, which is a variety of metamorphic rock that is an intermediate between a slate and a schist.

Oklahoma's Ever Changing Landforms
Constructive and Destructive Geologic Processes

Images of the Black Mesa, the Wichita, Arbuckle, and Ouachita Mountains and the Ozark Plateau provide examples of **destructive geologic processes**. Through weathering, the rocks that constitute these landforms are continually being broken into smaller particles. In some cases this weathering is the result of rainwater that fills fissures and cracks in a rock. As this water freezes and expands, it acts as a wedge, forcing pieces of rock apart.

In other cases, water and carbon dioxide from the atmosphere combine to make a weak acid. This acidic rainwater can slowly dissolve some types of rock, like limestone.

Erosion, which includes weathering and the movement of soil, rock, and other materials from one place to another, is also constantly changing the appearance of the landscape. Flowing water (runoff) and wind are two primary forces of erosion.

Through erosion, Oklahoma's hills, mountains, and buttes are slowly becoming smaller in size. At the same time, the sediments carried from the top and sides of these landforms are being deposited into places that lie below, such as valleys, creek bottoms, rivers, and lakes. This process of sediment deposition is called a **constructive geologic process**.

References

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