

Rock Types

Grade 4

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Science Content Standards: Grade 4, 4a — *Students know* how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).

Lesson Concept: There are three types of rocks that change through Earth processes.

Conceptual Flow:

- ▶ There are three types of rocks that can change through Earth processes: igneous, metamorphic, and sedimentary.
- ▶ Rocks have physical and chemical properties.
 - All rocks can weather to form more sediment.
 - All rocks can be melted.
 - All rocks can metamorphose.
- ▶ The three types of rocks are sedimentary, igneous, and metamorphic.
 - Sedimentary rocks are formed from breaking rock into smaller parts from weathering and from the remains of plants and other living organisms.
 - Igneous rock is from lava that has been cooled.
 - Metamorphic rock is formed by heat and pressure. Metamorphic rocks are formed from other rocks that are exposed to very intense heat or pressure.

Teacher Background:

The three types of rocks undergo dynamic due to Earth processes throughout geologic time. Rocks are usually made from combinations of different minerals and are identified from their composition and texture. Molten magma and lava cool and solidify to form igneous rocks. Rocks can change (metamorphose) chemically or physically when exposed to high temperatures and/or high pressure. Metamorphic rocks form when a parent rock of any type is subjected to significant increases in pressure and temperature, short of melting. Sedimentary rock forms when rock is weathered, transported by agents of erosion, deposited as sediment, and then converted back into solid rock—a process called lithification.

Rocks that are hard but show no layering are likely to be igneous rocks. Often they have interlocking crystalline textures. Rocks that are soft, particularly those with layers, are likely to be sedimentary rocks. They often have “fragmental” textures; they look like broken grains of older rocks cemented back together. Hard rocks that have their minerals lined up or arranged in uneven layers are likely to be metamorphic rocks. This description briefly depicts some of the most common rocks; however, there are many exceptions. (Adapted and excerpted from the *Science Framework for California Public Schools: Kindergarten Through Grade Twelve*.)

A rock is any solid mass of one or more minerals that occurs naturally and formed through geologic processes. A pebble, boulder, grain of sand, diamond, and hardened lava are rocks. A cement block, glass, and asphalt are human made and therefore not rocks.

Student Misconceptions

- Students confuse layers in sedimentary rocks with cleavage planes often associated with metamorphic rocks.
- Students describe igneous rocks with no ideas on formation.
- Metamorphic rocks – the word is associated with metamorphosis, so rocks are linked with butterflies and plants in general.
- Students may classify rocks as “crystal rocks” & “normal rocks”; crystal is used to describe both rock and mineral specimens but only if sample is thought to be attractive.
- Students get confused when deciding whether a sample is natural or not; they think that polished marble is not natural because has been touched by people, whereas brick is natural because it contains some natural materials.

Materials Needed for the Lesson:

Teacher Materials

- Poster showing the silt in the lake bed, the pebbles and boulders, the sand, etc. with the colors matching the clay
- “Rock Cycle Song” (sung in rounds to the tune of “Brother John” or “Frere Jacque”)
- Pre-shaken and settled “sediments in a jar”

Student Hands-on Materials (groups of four)

For each group of four students

- Red clay
- Blue clay
- Green clay
- Yellow clay
- Paper plates
- Plastic knives
- Newspaper

Student Handouts

- Probe “Is it a Rock or Not?” (Adapted from “Is it a Rock?” from *Uncovering Student Ideas in Science* Volume 2 by Page Keeley, et al.; National Science Teachers Association, 2007)
- “Rocks Can Change”

5E Lesson: Rock Types

| Teacher Does | Student Does | Concept |
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| <p>ENGAGE:</p> <ul style="list-style-type: none"> ▶ <i>Today we are going to do an activity about rocks and how they can change. A word that comes up all the time in Earth science is rocks. “What is a rock?”</i> ▶ <i>Here we are going to give you this paper and then you decide what a rock is.</i> <p>Distribute probe “Is it a Rock or Not?” (4 min. to complete)</p> <ul style="list-style-type: none"> ▶ <i>Who would like to share a rule to determine if something is a rock?</i> (Have 2-3 students share their rules.) <p>All of the items listed are rocks except for the piece of asphalt and the cement block. A rock is defined as any solid mass of mineral or mineral-like matter that occurs naturally as a part of our planet. Asphalt and cement are made using some rock material, combined with other material, and reshaped through human-made processes, not geological ones. If glass is obsidian (made by nature) it’s a rock; if made by people then it’s not a rock.</p> <p>Teach the “Rock Cycle Song” (sung to the tune of “Brother John”) to students.</p> <ul style="list-style-type: none"> ▶ <i>Sedimentary, sedimentary Igneous, Igneous Meta, meta morphic, Meta, meta morphic 3 types of rocks, 3 types of rocks</i> ▶ <i>Now we are going to show you that these types of rocks can change from one type to the other rock types.</i> | <p>Complete probe independently.</p> <p>Expected Student Response (ESR): A rock is something that is hard.</p> <p>Sing in rounds the “Rock Cycle Song” with teacher.</p> | <p>There are three types of rocks: igneous, metamorphic, and sedimentary.</p> |

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| <p><u>EXPLORE:</u></p> <p>Ahead of time, make a poster showing the silt in the lake bed; the pebbles and boulders; the sand; etc. with the colors matching the clay. It helps connect the model to the story. Makes a great visual.</p> <ul style="list-style-type: none"> ▶ <i>Today we are going to explore how metamorphic rocks are formed.</i> ▶ <i>Metamorphic rocks are formed from other rocks that are exposed to very intense heat or pressure.</i> ▶ <i>You will create a clay model that demonstrates one way metamorphic rocks can form. I will tell you a story about how some metamorphic rocks can be formed and you will work with the clay to show what happens.</i> ▶ <i>Before I get started on the story, you and your team members need to use your red and blue clay; make 20 red clay marble sized balls and 20 blues ones.</i> <p>Teacher demos how to form.</p> <ul style="list-style-type: none"> ▶ <i>Also you need to form two hand-sized “pancake” pieces from the green clay.</i> <p>Teacher demos how to make: split the green clay into half / one half for each “pancake.”</p> <ul style="list-style-type: none"> ▶ <i>You also need to split the yellow clay in half and make one “pancake”.</i> ▶ <i>Set all these aside and we will use them during the story.</i> <p>Distribute the clay and paper plates. Put directions on the board</p> <ul style="list-style-type: none"> ▪ 20 blue marbles ▪ 20 red marbles ▪ 2 green pancakes ▪ 1 yellow pancake <ul style="list-style-type: none"> ▶ <i>The story I am going to read to you describes process that actually occurs over millions of years. I said MILLIONS; so think about how long that is...humans have only been here on Earth for only a few thousand years. And our advanced society has only been here for 100 years.</i> | <p>Make clay balls and the “pancakes” (both yellow and green)</p> | <p>Metamorphic rocks are formed from heat and pressure.</p> |

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| <p>☛ Reveal parts of the poster as appropriate during the story.</p> <ul style="list-style-type: none"> ▶ <i>We will first start by creating a model of an ancient lake bed, the bottom of a lake. Into the ancient lake bed, over many thousands of years, streams carrying large amounts of greenish fine silt have deposited this silt into the lake.</i> <p>Have students place one of the green pancakes on the paper plate and explain that the green clay represents the silt.</p> <ul style="list-style-type: none"> ▶ <i>This now represents an ancient layer of green-colored silt.</i> ▶ <i>Do you think all silt is green colored?</i> ▶ <i>What color might silt be?</i> ▶ <i>Of course, it will most likely be brown. Now we will continue with our story.</i> ▶ <i>Over the next few thousand years rainfall in the area increases greatly. The amount of water in nearby streams is very high and the water is moving very quickly.</i> ▶ <i>When there is a lot of water moving very swiftly, what can happen?</i> ▶ <i>If it is carrying and moving rocks, what can happen to those rocks when they are being moved by the water?</i> ▶ <i>Swift moving streams and rivers wash away and transport, not only sediments, but even larger rocks and even boulders. The rocks and boulders become rounded as they roll and collide with other rocks in the stream or river. The smaller pieces become chipped and ground into smaller pieces of sediment. All these (boulders, rocks, small rocks and sediment) are deposited on the lake bed, on top of the fine grained sediment.</i> ▶ <i>Now, place the 20 red clay pieces (small rocks and pebbles) on the green clay.</i> <p>Have pre-shaken and settled “sediments in a jar” to show the students.</p> <ul style="list-style-type: none"> ▶ <i>Here is a model of sand and sediments that would move in a stream and what it would look like in the bottom of a lake or non-moving water.</i> | <p>ESR: No ESR: Brown</p> <p>ESR: it can carry stuff like logs and rocks; it can wash away the sides of the river</p> <p>ESR: They get broken and chipped; some of them get the rough edges broken away and they become smooth.</p> <p>Place the red clay spheres on the green “pancake”.</p> | |

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| <ul style="list-style-type: none"> ▶ <i>What do you notice about how the sediments have settled?</i> ▶ <i>Soon the river slows so it no longer can move bigger rocks and boulders, but it carries sand. The sand settles on top of the rocks and pebbles at the bottom of the lake.</i> ▶ <i>Why would the slower moving river no longer be able to move the boulders and be able to only move the sand?</i> ▶ <i>Now take your yellow “pancake” and put it on top of the red “marbles”/ pebbles and rock.</i> ▶ <i>Years later, the stream flow increases when the rains are especially heavy. This last for many years. More rocks, pebbles and boulders are moved and deposited in the lake along with another layer of silt.</i> ▶ <i>Add the blue clay marbles and then on top of that add the last green “pancake”.</i> ▶ <i>So now, anywhere from 1 to 3 million years have passed, let’s look at our model. Tell me what you see.</i> ▶ <i>So let’s look at this jar of stuff: there is sand, small pebbles and larger pebbles. These items were moved with a swift moving stream or river, how did they end up layering?</i> <p>After first model is made take time to have students make observations (layers are straight, round sediments in the middle</p> <ul style="list-style-type: none"> ▶ <i>Millions of years later, after the water in the lake disappeared and after the erosion of softer rocks surrounding the lake has occurred, the original lake bed is exposed at the surface. A fairly young stream cuts through one corner of the lake bed, exposing the sedimentary layers that form the lake bed.</i> <p>Model first what the students are to do:</p> <ul style="list-style-type: none"> ▶ <i>One person in your team, take a firm hold of the knife and slice one end of the model and set aside. We will use this portion for comparison later, so do not disturb it for now.</i> | <p>ESR: The bigger pieces are on the bottom, then comes small pieces like gravel and then comes the sand.</p> <p>ESR: The fast moving water has more power so it can move the big heavy stuff; the slow water does not have as much power or force.</p> <p>Put the yellow clay on top of the red clay “marbles”.</p> <p>Place the blue clay “marbles” and the green “pancake”.</p> <p>ESR: there is a skinny green layer, then some red clay “marbles”, then a yellow skinny layer, then blue “marbles, then green skinny layer.</p> <p>ESR: Bigger and heavier things on the bottom and the smaller lighter things at the top.</p> <p>One person cuts one small portion of the model and sets aside.</p> | |

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| <p>▶ <i>Over the next few thousand years, a major event occurs. A large hot body of magma slowly pushes itself toward the surface of the crust, directly beneath the lake bed. As this magma reaches higher and higher in the crust, the lake bed's sedimentary layers become heated and are subjected to tremendous pressure.</i></p> <p>Model first what students are to do:</p> <p>▶ <i>Each person in your group will place the top of their fist on the model and slowly push down on it as hard as they can for 3 seconds. This is modeling the pressure exerted by the hot magma.</i></p> <p>▶ <i>Millions of years later, state transportation officials construct a highway through the ancient lake bed, resulting in a road cut. A few years later, another road is constructed making an intersection.</i></p> <p>Model first before students do:</p> <p>▶ <i>First cut the lake bed in half, then cut it in half again, making four sections of the model (one for each person in the group)</i></p> | <p>Each person puts their fist into the model for 3 seconds.</p> <p>Cut the model in half and then in half again making four pieces.</p> | |
| <p>EXPLAIN:</p> <p>Provide student handout "Rocks Can Change".</p> <p>▶ <i>In the first square draw a cross section of sample #1 (the first slice). Name the type of rock. In the second square draw sample #2. Name the type of rock. How can you tell the difference between a sedimentary and a metamorphic rock?</i></p> <p>▶ <i>Write words that describe each model rock sample; use the words in the word bank.</i></p> <p>On the board write the words <i>even</i> and <i>uneven</i>, with a picture showing what is meant by even and uneven layers.</p> <p>Collect papers.</p> | <p>Complete student handout.</p> <p>ESR: The sedimentary rock is more even in layers. The pieces in the layers are more rounded. Metamorphic rock the layers are uneven and curvy.</p> | |

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| <p>▶ <i>Hard rocks that have their minerals line up and arranged in uneven (wavy) layers are likely to be metamorphic rocks. Rocks that are soft, particularly with layers, are likely to be sedimentary rocks.</i></p> <p>▶ <i>In our model, which was the sedimentary rock and which was the metamorphic rock?</i></p> <p>Show the two examples from the model.</p> | <p>ESR: Sample #1 is the sedimentary because the layers are more even and Sample #2 is metamorphic because it is squished together and uneven.</p> | |

Input Question: What do you notice about how the sediments have settled? (in Explore section)

Process Question: How can you tell the difference between a sedimentary and a metamorphic rock? (in Explain section)

Output Question: These items were moved with a swift moving stream or river, how did they end up layering? (in Explore section)

STUDENT HANDOUT
Rocks Can Change

Word Bank: even layers, uneven thickness of layers, rounded sediments, flattened sediments

| Sample #1 | Sample #2 |
|---|---|
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STUDENT HANDOUT

Is It a Rock or Not?

Check those items listed below that are rocks:

_____ Pebble

_____ Cement block

_____ Piece of asphalt

_____ Boulder

_____ One grain of sand

_____ Diamond

_____ Hardened lava

_____ Glass



Explain why you identified some items to be rocks and some items not to be rocks.
