

WHAT IS THE ROCK CYCLE?

Unit 5: Physical Features of the Earth

Lesson 11 — Grades 4-5

INSTRUCTIONS



Overview

In this lesson, students will conduct an investigation to learn how rock changes from one type to another in the rock cycle.

Objectives

On successful completion of this lesson, students will be able to:

- explain the rock cycle; and
- identify properties of sedimentary, metamorphic, and igneous rock.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

- [4] SA1.2 The student demonstrates an understanding of the processes of science by observing, measuring and collecting data from explorations and using this information to classify, predict, and communicate
- [4] SD1.1 The student demonstrates an understanding of geochemical cycles by describing that most smaller rocks come from the breaking and weathering of larger rocks as part of the rock cycle
- [5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations to create their own inferences and predictions
- [5] SD1.1 The student demonstrates an understanding of geochemical cycles by observing a model of the rock cycle showing that smaller rocks come from the breaking and weathering of larger rocks and that smaller rocks (e.g., sediments and sands) may combine with plant materials to form soils

Alaska Cultural Standards

- [A] Culturally knowledgeable students are well grounded in the culture heritage and traditions of their community. Students who meet this cultural standard are able to:
- [A.3] acquire and pass on the traditions of their community through oral and written history.
- [B] Culturally knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:
- [B.2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.
- [D] Culturally knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:



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[D.4] gather oral and written history information from the local community and provide an appropriate interpretation of its cultural meaning and significance.

Bering Strait School District Scope & Sequence

4th Grade Sequence #7: Physical Features of the Earth

5th Grade Sequence #9: Physical Features of the Earth

Materials

- sand
- pebbles and small stones
- small bucket
- cheese grater or pencil sharpener
- crayons of at least three different colors
- plastic baggies (same number as color of crayons)
- metal cookie sheet
- wax paper
- iron
- aluminum pie pan
- toaster oven
- oven mitt or other hot pad
- Student Worksheet: The Rock Cycle

Multimedia

REACH Multimedia 4-6: "What is the Rock Cycle?"

Available at www.k12reach.org

Additional Resources

HSP IV: Ch. 8, Lessons 1, 2; Ch. 7, Lesson 3

HSP V: Ch. 9, Lessons 1, 2; Ch. 7, Lesson 3

HSP V: p. 360 — "Science Spin"

Activity Preparation

1. Use a cheese grater or a pencil sharpener to make crayon shavings of at least three different colors. Store each color in a separate plastic baggie.





2. Put the sand and the pebbles or small stones into the bucket.
3. At the beginning of the lesson, turn the iron on and let it pre-heat to a medium-warm setting. Turn the toaster oven on to a medium-high / high setting. Ensure that students do not touch the iron or the toaster oven.

Whole Picture

Geologists group rock into three main classifications: igneous, metamorphic, and sedimentary. Each type of rock can change into any of the others depending on a series of geologic forces. The changing process is constantly ongoing and is known as the rock cycle.

Sedimentary rock is formed of small fragments, or sediments, like sand, pebbles, fossils, and other bits of earth, which have accumulated in layers and hardened into stone over time. Generally, sedimentary rock is fragile and can easily be broken down into individual sediments by weathering and erosion. Types of sedimentary rock include: limestone, breccia, chert, shale, coal, rock salt, conglomerate, sandstone, dolomite, flint, siltstone, and iron ore.

Metamorphic rock is formed as the result of great heat and pressure. The metamorphosis of sedimentary or igneous rock into metamorphic rock takes place under Earth's surface, and often results in ribbon-like layers or shiny crystals. Metamorphic rock includes: gneiss, marble, schist, slate, soapstone, quartzite, hornfels, and phyllite.

Igneous rock is formed when sedimentary or metamorphic rock is melted into magma (magma is called lava when it erupts through Earth's surface), and then cools and hardens into stone. The cooling and hardening process can happen both on the surface (as in the case of a volcanic eruption) or beneath the surface. Igneous rock can be smooth and glass like, if it cools very quickly, or it can be marked with many tiny holes where air and gas bubbles formed during the cooling process. Igneous rock types include: basalt, obsidian, granite, pumice, andesite, diorite, scoria, and thylolite.

It is important to note that any type of rock can be formed into any other type.

Traditional Native knowledge, rooted in millennia of observation and tied closely to spiritual belief has a different way of explaining rocks and landforms. Alaska Native elders and culture bearers "share with geologists a deep appreciation for how much has changed from the days, as they say, *nuna mamkitellrani* (when the land was thin)" (Fienup-Riordan and Rearden, 2012, p.45).

For instance, in their creation stories, elders share that Nelson Island was created by Raven, who turned the sea ice into stone and earth. Evidence of this history can be seen in the rock formations known as *qairuat* (literally, "pretend waves"), near Toksook Bay. Susie Angaiak of Tununak explained that "In the mountains up there are rocks piled like ice ... [these] are said to mark where ocean waves hardened when Raven created Nelson Island" (Fienup-Riordan and Rearden, 2012, p.46).

Similarly, the Alaska landscape is dotted with granite rock formations, which tell stories not only of the Earth's geologic past, but of ancestors who were frozen in stone "when they [experienced] a frightening situation" (Fienup-Riordan and Rearden, 2012, p.48). One such example can be



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seen inland from Elqialek, where stone people can be seen fighting over a stone walrus. Another is the story told by John Andrew of Kwethluk about a woman and child who were frozen in stone after becoming lost from her husband: “The couple was coming home from their camp, from the hills, the man was rowing down in a skin boat, and his wife and child were going on the ground right through the hills here. And he lost her in the hills somewhere, couldn’t find her. After he got back to where they were going, he went back to look for her. And they found her on the side of the mountain, but she had turned into a stone, too. If you see it to this day from a distance, it will be the shape of a woman with a child on the back” (Fienup-Riordan and Rearden, 2012, p.54).

Vocabulary

rock	a natural substance made of one or more minerals.
rock cycle	the sequence of processes that change rocks from one type to another over long periods.
igneous rock	rock that forms when melted rock cools and hardens.
sedimentary rock	rock formed when sediments are cemented together.
metamorphic rock	rock formed when high heat and great pressure change existing rocks into a new form.

Activity Procedure

1. Show students the bucket containing the sand and pebbles. Tell them that the sand and the pebbles are part of the same cycle — the rock cycle.
2. Ask students the following questions (let them speculate, they will discover the answers in the activity).
 - a. How are rocks and sand related?
 - b. Does ocean water affect rocks?
 - c. Does river water affect rocks?
3. Tell students that heat and pressure are part of the rock cycle, but that it would be impossible to observe this in real life — a human could not survive the conditions! As a class you will participate in an activity that models the rock cycle. Review with students that scientists use models on a regular basis to understand processes that they cannot observe directly.
4. Ask for a student volunteer. Instruct the volunteer to make three layers of crayon shavings on the cookie sheet (one layer from each color).
5. Instruct a second volunteer to press down the layers with his / her hand.
6. Instruct all students to observe the pile of shavings and draw what they observe in Step 1 on their Student Worksheet: The Rock Cycle. Explain that this step represents sedimentary rock — rock formed when sediments are cemented together.





7. Place a sheet of waxed paper over the shavings. Press down lightly with a warm iron. Let the iron sit for only a few seconds, so that the shavings soften, but do not melt completely.

Note: This step represents the formation of metamorphic rock. If the shavings melted at this stage, it would represent the formation of igneous rock.

8. Let the shavings cool for a few minutes. Before allowing students to touch the block, ensure that it has cooled. Explain that this step represents the formation of metamorphic rock — rock that is formed when high heat and pressure change the existing rock into a new form. Instruct students to draw what they observe in Step 2 on their Student Worksheet.
9. Ask a student volunteer to place the block of shavings into the aluminum pie pan. Place the pan with the shavings into the toaster oven, and allow the shavings to melt completely.
 - a. If possible, allow students to look into the oven periodically to observe the melting. Ensure that students do not touch the toaster oven.
10. When the shavings have melted, use the oven mitt or hot pad to remove the pie tin, and allow the shavings to cool.
 - a. You may allow students to observe the melted wax at this point, but do not let them touch either it or the tin.
11. Once the shavings have cooled, students may touch and observe the new form. Explain that this step represents the formation of igneous rock — rock that is formed when melted rock hardens and cools. Instruct students to draw what they observe in Step 3 on their Student Worksheet.
12. Explain to students that weathering is what breaks larger rocks into smaller pieces. This process can happen from wind, waves, water, ice, and plants. Ask students to consider the “igneous rock” they have just created. Can they think of a way to make it into “sedimentary rock” again?
 - a. Use a grater to grate some of the block into small pieces again. Set the solid block next to the grated pieces, and have students observe it, drawing what they see on their Student Worksheet, in Step 4.
 - b. Explain that this is what happens in nature, over long periods of time. This whole process is called the “rock cycle.”
13. Check for student understanding: call on students to explain the process of the rock cycle (Materials in rocks continuously change. Processes in the cycle include:
 - a. the melting, cooling, and hardening of rock (igneous rock);
 - b. movement of sediment (erosion — students will learn about this in later lessons);
 - c. the deposition and subsequent hardening of sediment in layers (sedimentary rock); and
 - d. the changing of rock by high heat and great pressure (metamorphic rock).
14. Ask students if there is a “first” and “last” step in the rock cycle (Answer: No. The rock





cycle is a never-ending cycle. Be sure that students understand that any step can follow any other (for example, in Step 7 above, had the iron melted the crayon sediments, it would have gone from sedimentary to igneous. Similarly, had a grater been used after the formation of the metamorphic, it would have gone from metamorphic to sedimentary.

15. **HOMEWORK:** Instruct students to observe the landscape around the school and village, and note any particularly interesting rocks or landscape features. Students should ask their family and community members about these formations and find out if there are any stories associated with them. Students then share these stories with the class at a specified time.
 - a. **ALTERNATIVELY:** Make note of any stone or landscape features before starting this lesson. Ask local community members to share with you any stories about these (or other) formations, and share them with the class. If possible, have the culture bearer or elder visit your classroom to share these stories firsthand.

Extension Activities

1. Make sedimentary and metamorphic rocks using clay.
 - a. Use small round pieces of clay (of different colors) to make a model of a sedimentary rock. Remember that sedimentary rocks are made of particles that are stuck together in layers.
 - b. After a model sedimentary rock has been made, put pressure on the model, squashing down the layers. This models the pressure that can be put on sedimentary rock to change it into metamorphic rock.

Answers

Step 1: Students should list three colors of crayon in the “Materials Section.” In the “Observation” section, they should draw a pile of layered “sediments” (each a different color). Each layer in the pile should be distinct and should show the individual specks of crayon. (This step represents the formation of sedimentary rock.)

Step 2: Students should list the materials from step one in addition to waxed paper and an iron. In the “Observation” section, students should draw a picture in which the distinct particles are still observable, but where the parts have solidified into a solid mass. (This step represents the formation of metamorphic rock.)

Step 3: Students should include the materials from step one, as well as a pie plate and toaster oven. In the “Observation” section, students should have a new solid mass of color, one in which the individual particles can no longer be distinguished. (This step represents the formation of igneous rock.)

Step 4: Students should include the block of “igneous rock” from Step 3, as well as a grater. In the “Observation” section, they should draw a new pile of “sediment” next to the more solid “igneous” block. (This step represents the re-formation of sedimentary rock.)



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References

Fienup-Riordan, Ann, and Alice Rearden. (2012). *Ellavut: Our Yup'ik World and Weather. Continuity and Change on the Bering Sea Coast*. Seattle and London: University of Washington Press.

Geology.com (geology.com/rocks).



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Student Worksheet: The Rock Cycle

Name: _____

Observation Chart

Materials	Observation	Type of Rock Represented
Step 1:		
Step 2:		
Step 3:		
Step 4:		



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