Rock Cycle

NC Standard ESS.6.2.3

Activity Description & Estimated Class Time

In this two-class-period activity, students explore relationships between different rock types and the forces that change one into another (the rock cycle). In Part 1, students use a Lab-Aids activity and take on the role of a rock or part of a rock, and move among stations. At each station is a spinner that randomly describes things that can happen to the rock and directs students to other stations. In analyzing their movement among the stations, students learn about the conditions that change the rock and the vast amount of geologic time involved. In Part 2, students will work in groups to identify rocks based on short narratives. Students use evidence and reasoning to support their claims about the rock type.

Correlations to NC Science Standards

ESS.6.2.3 Use models to explain the rock cycle and its relationship to the formation of soil (including how different types of soil come from different types of rocks).

Learning Target

Students will demonstrate knowledge and understanding of:

- The general processes involved in the rock cycle (e.g., the cooling of lava, heat and pressure transforming sediment into rock, weathering, erosion).
- how forces deep inside Earth and at the surface produce a slow cycle that builds, destroys, and changes the rocks in the crust.
- how plate tectonic processes affect the processes of the rock cycle
- how evidence can be used to explain the causes of a rock's appearance based on processes in the rock cycle

Brief Science Background

Rocks and soil may appear permanent, but Earth's materials are constantly changing through a process called the rock cycle. Forces such as heat, pressure, gravity, erosion, and plate movement break apart, move, and transform rocks over time. Deep inside Earth, heat can melt rock into magma, while gravity and erosion move rock materials across Earth's surface.

There are three main types of rocks. Igneous rocks form when melted rock cools and hardens. Magma that cools slowly underground forms rocks with large crystals, while lava that cools quickly at the surface forms rocks with very small crystals. Sedimentary rocks form from layers of sediment that are compacted and cemented together near Earth's surface. Metamorphic rocks form when existing rocks are changed by intense heat and pressure without melting completely.

Part 1 - The Rock Cycle: An Interactive Exploration

Materials

Materials for the whole class

- 1 Lab-Aids Teacher's Guide for The Rock Cycle: An Interactive Exploration
- A set of 8 spinner stations.

Materials for groups of 2

- 1 copy of The Rock Cycle: An Interactive Exploration Student Worksheet and Guide.
- Rock Information, SD 1

Preparation

Place the 8 spinner stations around the room with enough space between them to avoid crowding.

Procedure

This procedure has been adapted from the Lab-Aids Teacher's Guide.

1. Distribute the Student Guides and explain that for the next 25 minutes, they will be a particle of earth material moving through the rock cycle.
2. Have the groups count of by 8's to determine their starting point and have students go to the corresponding spinner.
3. Explain that together as a class you will go through the first round of the procedure together as a class. Once they are at their starting points, have students write their starting station number in the appropriate box in the top row of the data table on the next page. Write the station name and place a hash mark in the appropriate box in the top row of your data table.
   For example, if the student is at station #1, they should write 1 in the # column, Magma in the name column, and place one hash mark in the hash mark column.
4. Students will then spin the spinner and see where the arrow points.
   - If it directs them to go to a different station:
     - they should write the notes in the notes section of the top row
     - walk to the correct new station
     - write in the station number and name in the second row of the data table

     For example, the student at station 1, spins, and it lands on "cooled slowly below the surface they should go to station #5", the student will write cooled slowly below the surface in the notes column of the first row. They would then go to station #5 and write the information for station 5 in the second row.
   - If it directs them to remain at the same station have them place another hash mark in the hash marks box.
5. Students will continue step 4 until you direct them to stop.
   Periodically let students know how much time remains. This allows the students to focus upon the activity and the results they are obtaining.
6. When the time has passed, direct students to complete Step 5, the "Number of Years" calculation for each column.
7. Next, ask the students to complete Step 6 and draw arrows connecting the stations on the Rock Cycle diagram in the order recorded on their Data Table. Please see the sample student diagram in the teacher's guide.

Content Connection

1. Give each student a rock information sheet, and have them write out responses to analysis questions 1-6 on their student worksheet and guide. Discuss results as a class.
   A class discussion should emphasize the diverse pathways that class members followed as they moved through the cycle.
2. Allow students to research their area and answer questions 7-9 on their student worksheet and guide. Have students compare their findings and then hold a class discussion.

Part 2 - Rock Detectives

For this part of the activity, students will work in groups to identify rocks based on short narratives. The primary goal is for students to determine the rock type: sedimentary, igneous, or metamorphic, using clues provided in the story. Once students identify the rock category, they will use additional evidence from the narrative to determine the specific rock type.

The emphasis of this activity should be on students using evidence to support their claims about the rock type. Students should be encouraged to explain their reasoning, cite clues from the narrative, and justify how the evidence supports their conclusions.

Materials

Materials for the whole class

- A teacher set of identified samples of
  - Sedimentary Rocks
  - Igneous Rocks
  - Metamorphic Rocks
- Ability to project Rock Cycle PowerPoint from www.ciblearning.org

Materials for groups of 4 students

- 1 set of 6 sedimentary rock samples
- 1 set of 6 igneous rock samples
- 1 set of 6 metamorphic rock samples
- Rock Information, from Part 1, 1 for each student
- Rock Detectives Student Activity Sheet, SD 2, 1 for each student
- Rock Stories, SD 3
- Identified Sample Photos, SD 4

Preparation

Make a copy of the Rock Detectives Student Activity Sheet, SD 2, for each student, and a copy of Rock Stories, SD 3 for each group.

Procedure

1. Hold up a mystery rock from one of the sample boxes and ask:
   - "What clues could help us figure out how these rocks formed?"
   - "Do all rocks form the same way?"
   - "What might a rock's texture, weight, or appearance tell us?"
2. Set up groups and provide each group with the necessary materials.
3. Tell students, "Today you are geologists solving rock mysteries. Each rock has a story hidden inside it. Your job is to use evidence to determine what type of rock it is and identify its specific name."
4. Project Rock Story 1 from the Rock Cycle PowerPoint. Read the story aloud. As you read the story, have the students circle key information to help them identify the rock.
5. Ask the students "What clues stand out? What do these clues tell us?"
   They may circle: formed from volcanoes, cools into a solid, traps bubbles, light.
6. Next, ask what type of rock, sedimentary, igneous, or metamorphic, the story is referring to, and support their answer with evidence.
7. Discuss as a class and have the students complete the information for Story 1 on SD 2
   The story is about an igneous rock because igneous rocks form from melted rock/lava.
8. Have the students look at the rocks in the igneous rock box and project the igneous rock identified sample photos from the PowerPoint. Using the story, SD 3, and the

Procedure cont.

Rock Information sheet, the group will work to identify the specific rock.

9. Discuss as a class and have the students complete the information for Story 1 on SD 2.
   The story is about a Pumice rock. Some clues include that bubbles were created and trapped and it is very light.
10. Have students repeat the process for the rest of the stories. They will record their claim, evidence, and reasoning for each story on SD 2.
11. When everyone has finished, discuss the answers as a class. Make sure the student provides their evidence and reasoning for responses.
    Story 2 - Type: Sedimentary, Name: Conglomerate
    Story 3 - Type: Sedimentary, Name: Limestone
    Story 4 - Type: Igneous, Name: Gabbro
    Story 5 - Type: Metamorphic, Name: Slate
    Story 6 - Type: Metamorphic, Name: Gneiss
    Story 7 - Type: Igneous, Name: Basalt
    Story 8 - Type: Sedimentary, Name: Breccia
    Story 9 - Type: Metamorphic, Name: Marble

Content Connection

1. Have students create a rock story for any rock that does not already have one. Requirements:
   - Include clues about formation
   - Describe observable properties
   - Avoid naming the rock directly
   - Include evidence that another student could use to identify it
2. Have students exchange stories with classmates and solve each other's mysteries

SD 1

Rock Information

Igneous Rocks

When molten rock, called magma, cools and solidifies, the resulting rock is an igneous rock. Igneous rocks are the predominant rock type found inside the Earth. They are also found at the surface near convergent and divergent plate boundaries and above hot spots. Magma that solidifies beneath the Earth's surface cools slowly, forming plutonic igneous rocks with large crystals visible to the naked eye. Valuable mineral deposits are commonly associated with plutonic rocks. Magma that erupts onto the earth's surface, where it is then called lava, cools very quickly, forming volcanic igneous rocks and much smaller crystals - sometimes so small that the rock is glassy (obsidian). Other times, volcanic rocks are filled with so many air holes that the rock will float! The color and density of igneous rocks are determined by the minerals that make up the magma and the amount of gases trapped within the rock. Igneous rocks are classified according to a variety of schemes based upon composition, texture, and density.

Sedimentary Rocks

Sedimentary rocks are formed on, or very near to, the surface of the Earth. Sedimentary rocks are the most common rock type found on the Earth's surface. Rocks and soils found at or near the earth's surface are constantly exposed to a variety of environmental influences, including heat, cold, gravity, water, and wind. As a result, rocks are broken into fragments and sediments (through weathering) and transported to low areas on the earth's surface (such as the floors of ocean basins and large lakes). Here, accumulated sediments are compacted by gravity and the weight of overlying sediments into layers of clastic sedimentary rock such as shale, sandstone, and conglomerate. The red rocks of the Colorado Plateau were formed in this way, as were rocks making up the hills of the South Dakota Badlands and the Ozarks of Arkansas. Minerals can also dissolve in water bodies and, when conditions permit, precipitate to form chemical sedimentary rocks such as limestone and gypsum. Both clastic and chemical sedimentary rocks can be made primarily of material from living things, such as coquina, chalk, and coal. Sedimentary rocks frequently contain fossils and often exhibit evidence of water movement. Because sediments are deposited in layers, often caused by seasonal fluctuations, catastrophic events, or long-term processes, sedimentary rocks are typically layered.

Metamorphic Rocks

Rocks exposed to heat and pressures that are great, but not great enough to melt them to magma, can undergo significant transformations and be transformed into metamorphic rocks with new minerals and pressure-related structures. There are two major categories of metamorphic rocks: regional and contact. Regional metamorphic rocks are larger areas of metamorphic rocks that form from large-scale changes in pressure and temperature, often occurring as rocks become buried at depth within the crust or subjected to forces and conditions associated with convergent boundaries. Regional metamorphic rocks often have a layered appearance, called foliation, that arises in response to, and forms banding roughly perpendicular to, the direction of the force producing increased pressure. Contact metamorphic rocks tend to be smaller, more localized, and form from the elevated temperatures associated with adjacent pockets of hot magma.

SD 2
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Rock Detectives: Student Activity Sheet

Name:

Rock #1	Type of Rock: Evidence to support:	Rock Name: Evidence to support:
Rock #2	Type of Rock: Evidence to support:	Rock Name: Evidence to support:
Rock #3	Type of Rock: Evidence to support:	Rock Name: Evidence to support:
Rock #4	Type of Rock: Evidence to support:	Rock Name: Evidence to support:
Rock #5	Type of Rock: Evidence to support:	Rock Name: Evidence to support:
Rock #6	Type of Rock: Evidence to support:	Rock Name: Evidence to support:

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Rock Detectives: Student Activity Sheet

Rock #7	Type of Rock: Evidence to support:	Rock Name: Evidence to support:
Rock #8	Type of Rock: Evidence to support:	Rock Name: Evidence to support:
Rock #9	Type of Rock: Evidence to support:	Rock Name: Evidence to support:

Create a rock story for any rock that does not already have one.

- Include clues about formation
- Describe observable properties
- Avoid naming the rock directly
- Include evidence that another student could use to identify it

SD 3
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Rock Stories

Story 1

This rock is formed from volcanoes near or under the sea. When lava leaves a volcano, the pressure release can make it foam like carbonated soda, creating bubbles. When this super-heated lava contacts water, it cools into a solid almost instantly, creating a very light rock. As it quickly solidifies, it traps bubbles inside thin glassy walls.

Story 2

This rock forms where small rounded rocks or pebbles accumulate in sediments. Powerful currents in water are necessary to move and round the pebbles that make up this type of rock. As a result, it usually occurs where there is or has been a fast stream or a beach with strong waves. The pebbles in this rock are usually cemented together by silica, calcite or iron oxide

Story 3

This rock forms in shallow ocean water, where pieces of shell, coral, fragments of skeletons and algae accumulate. When animals that use calcium carbonate in their shells and skeletons die, they settle on the ocean bottom and collect. Because of this, some of these rocks are filled with fossils.

Story 4

This rock is formed when molten magma slowly cools deep in the Earth, often below the sea. This magma pushes up and cools very slowly, over millions of years. Because it cools so slowly, it forms large crystals. Large deposits of it are in the crust under the oceans and also on the moon. It is sometimes used for kitchen countertops where it is incorrectly called “black granite.”

Story 5

This rock often forms in basins between convergent plate boundaries where a shale-type sedimentary rock made of clay or volcanic ash is subjected to heat and pressure. Relatively little heat and pressure are needed to make it. It is extremely finegrained, with many thin layers. Its color is largely determined by the amount of iron it contains, but it is normally a shade of gray.

Story 6

This rock forms when intense heat and pressure partially melt and compress granite or sedimentary rocks. These high temperatures and pressures occur as tectonic processes such as continental collisions or subduction push rock deep in the Earth. With this rock, the materials it is composed of (minerals) stay more or less the same. However, their structure changes to become much more layered, producing clear alternating layers of light and dark.

SD 3
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Rock Stories

Story 7

This rock is one of the most common rocks found in Earth's ocean crust and around volcanoes. It forms when lava cools quickly at Earth's surface, creating crystals that are very small and difficult to see. It is a dark, dense rock rich in minerals like iron and magnesium.

Story 8

This rock forms where jagged fragments of rock or mineral debris accumulate. This can happen at the base of an outcrop where weathered debris accumulates or in streams near an outcrop of rock. It can also be formed when tectonic forces break brittle rock in a fault zone. It is almost always made of angular pieces surrounded by a fine-grained matrix.

Story 9

This rock began as limestone deep underground. Over time, tectonic forces pushed it farther into the Earth where it was exposed to intense heat and pressure. These conditions caused the tiny calcite pieces in the limestone giving it a smooth, sparkling appearance. Some samples can be white, while others have colorful swirls or streaks caused by materials like clay, sand, silt, or iron.

SD 4
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Identified Rock Samples: Igneous

Gabbro



DIRK WIERSMA/SCIENCE PHOTO LIBRARY

Vesicular Basalt



DIRK WIERSMA/SCIENCE PHOTO LIBRARY

Pumice



Cakra Wiradana / Dreamstime

Basalt



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Philippe Clement/Nature Picture Library

Graphic Granite



Alamy

Diorite



VvoeVale

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Identified Rock Samples: Sedimentary

Limestone



Getty Images/iStockphoto

Shale



Dorling Kindersley/UIG/SCIENCE PHOTO

Conglomerate



Dreamstime.com

Coal



geologyscience.com/rocks/coal/

Sandstone



ANDREW J. MARTINEZ/SCIENCE PHOTO

Breccia



Dreamstime.com

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Identified Rock Samples: Metamorphic

Slate



Adobe

Schist with Garnet



Alamy

Gneiss



Andrew J. Martinez Photography

Schist



Alamhy

Quartzite



Alamy

Marble



Alamy