

Modeling the Rock Cycle



SUBJECT: Science

GRADE LEVEL: 4-7

DURATION: approximately 60 min

ACTIVITY SUMMARY: Students will use crayons to model the processes that create igneous, sedimentary, and metamorphic rock.

OBJECTIVES:

Students will be able to:

1. Explain the processes of weathering, erosion, deposition and lithification.
2. Summarize the rock cycle.

TEKS ADDRESSED:

4th grade

1A-demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations.

3C-represent the natural world using models such as rivers, stream tables, or fossils and identify their limitations, including accuracy and size.

7B-observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

5th grade

1A-demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations.

7A-explore the processes that led to the formation of sedimentary rocks and fossil fuels.

6th grade

1A-demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards.

3B-use models to represent aspects of the natural world such as a model of Earth's layers.

3C-identify advantages and limitations of models such as size, scale, properties, and materials.

10B-classify rocks as metamorphic, igneous, or sedimentary by the processes of their formation.

7th grade

1A-demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards.

3B-use models to represent aspects of the natural world such as human body systems and plant and animal cells.

3C-identify advantages and limitations of models such as size, scale, properties, and materials.

8B-analyze the effects of weathering, erosion, and deposition on the environment in ecoregions of Texas.

NATIONAL SCIENCE STANDARDS:

Content Standard D: Earth and Space Science

Grades 5-8

Structure of the Earth System

- Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.
- Some changes in the solid earth can be described as the "rock cycle." Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.

MATERIALS:

Crayola crayons, plastic hand-held pencil sharpener, aluminum foil, wax paper, hot plate, ice cubes, plastic knife

BACKGROUND:

The rock cycle describes the relationships between the three major types of rock: igneous, sedimentary, and metamorphic. Igneous rocks form from the cooling of molten rock (magma). Sedimentary rocks form as the pressure of overlying layers compacts the sediment into rock. Metamorphic rocks form from other rocks that are exposed to intense heat and pressure and as a result change their physical and/or chemical form.

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Some processes of the rock cycle include weathering, erosion, deposition, and lithification. Weathering is the process of breaking down rocks to produce sediment or soil. The rate at which weathering occurs depends on the climate and type of rock being weathered. Weathering usually occurs too slowly to notice and can be one of 2 types. Physical weathering is the breaking down of rock into smaller pieces (also known as mechanical weathering). Chemical weathering occurs when rocks are broken down because of chemical reactions. Erosion occurs when weathered rock and soil are moved from one place to another. Deposition is the actual dropping of the sediment in a new location. These processes are often caused by moving water but can also be caused by gravity, wind, and glaciers. Lithification involves the compaction and cementation of sediments to form the rock layers.

Molten rock or magma solidifies into igneous rock (the whole crayon at the start of the lab). If the cooling takes place rapidly at the Earth's surface then extrusive igneous rocks form. If the cooling takes place slowly under the earth's surface then intrusive igneous rocks form. As these rocks are exposed to erosion and weathering, they are broken down into sediment (pile of crayon shavings). The sediment may be transported (eroded) long distances by water, wind, or gravity and eventually be deposited in layers. As more sediment layers build up on top of each other, the sediments are compacted and cemented together into sedimentary rock (squishing the crayon shavings together). This process is called lithification. With heat and pressure (partial melting) the rock will undergo a physical and/or chemical change into metamorphic rock. If the rock is melted completely and cooled, igneous rock is once again formed.

PROCEDURE:

Part 1: Weathering

1. Each crayon represents an igneous rock. On the diagram, students should write "igneous rock" in the box at the top left of the circle.
2. Use the sharpener to shave off small pieces of 4 different colors of crayon. Make 4 different piles on a piece of wax paper. Use a plastic knife to break the shavings into smaller pieces.
 - a. What process does this represent? (*weathering*)
 - b. What do the shavings represent? (*sediment*)
 - c. Are all the "rock fragments" the same size? Why or why not?
 - d. What are some of nature's weathering forces? (*wind, water, gravity*)

Part 2: Erosion and Sedimentation

1. Obtain a piece of aluminum foil from your teacher and fold it in half.
2. You are now the erosion force. Carefully "erode" (move) one color of your sediment and put them in the center of the foil making an 8cm x 8cm layer of sediment.
3. Add a second color of sediment. Continue until all colors have been added to the layers of sediment.
4. On the diagram, the arrow from "igneous rock" can be labeled "weathering and erosion" and the next box can be labeled "sediment."
5. When finished, fold each side of the foil over the sediment. Allow a little distance between the shavings and each fold as room for expansion.
 - a. What process does the laying down of sediment represent? (*deposition*)

Part 3: Compaction, Cementation, and Lithification


1. Place your aluminum foil packet on the floor.
2. Compress the packet by carefully standing on it.
3. Carefully open the packet and break the compressed central region. Look at the broken edges and describe the layers.
 - a. How do they compare to the original layers?
 - b. What happened to the spaces between the fragments?
4. On the diagram, the arrow from “sediment” can be labeled “lithification—compacting and cementing sediments together.” The next box can be labeled “sedimentary rock.”

Part 4: Metamorphism

1. Make a small boat from your aluminum foil. Put your rock from part 3 and any leftover shavings in the boat.
2. Place the boat on a warm hotplate. **CAUTION: HEAT!** Watch as the heat melts the crayon.
3. Remove the foil when the wax is soft to the touch (*use the plastic knife, not your fingers to check this*) and the colors have swirled together but not so much that the colors are indistinguishable. Let the wax cool.
 - a. How is this process of creating metamorphic rock different from the actual process? (*In real life, there is no melting. The change is caused by heat and pressure.*)
4. On the diagram, the arrow from “sedimentary rock” can be labeled “metamorphism—heat and pressure transforms the rock.” The next box can be labeled “metamorphic rock.”

Part 5: Igneous Rock Formation and Volcanic Activity

1. Put the metamorphic rock back in the foil boat and put it back on the hot plate.
2. Allow the wax to melt until a smooth pool of liquid wax forms and the colors blend together uniformly.
 - a. What will this create? (*magma*)
3. While it is heating, make a bowl-shape with another piece of aluminum foil and put 3-4 ice cubes in it.
4. When your “magma” has formed, “erupt your volcano so lava flows” (carefully pour it) over the ice cubes. After it has cooled, remove your igneous rocks.
 - a. What type of igneous rock has formed? (*extrusive*)
 - b. Do you see any crystals?
 - c. What kind of texture and shape do you see?
5. Clean up your lab station. Turn off the hotplate. Throw away all wax paper, aluminum foil, and crayon shavings. Check with your teacher about what to do with the rock.
6. On the diagram, the final arrow from “metamorphic rock” can be labeled “melting then cooling.”

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7. Add additional arrows across the middle of the diagram to illustrate that any type of rock can turn into any other type of rock. Label the arrows with the processes that cause the transformation

EVALUATION:

Students can be evaluated through their answers to the lab questions.

Name: _____

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Some processes of the rock cycle include weathering, erosion, deposition, and lithification. Weathering is the process of breaking down rocks to produce sediment or soil. The rate at which weathering occurs depends on the climate and type of rock being weathered. Weathering usually occurs too slowly to notice and can be one of 2 types. Physical weathering is the breaking down of rock into smaller pieces (also known as mechanical weathering). Chemical weathering occurs when rocks are broken down because of chemical reactions. Erosion occurs when weathered rock and soil are moved from one place to another. Deposition is the actual dropping of the sediment in a new location. These processes are often caused by moving water but can also be caused by gravity, wind, and glaciers. Lithification involves the compaction and cementation of sediments to form the rock layers.

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 - a. What process does this represent? _____
 - b. What do the shavings represent? _____
 - c. Are all the "rock fragments" the same size? Why or why not? _____

 - d. What are some of nature's weathering forces? _____

Part 2: Erosion and Sedimentation

1. Obtain a piece of aluminum foil from your teacher and fold it in half.
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4. On the diagram, the arrow from "igneous rock" can be labeled "weathering and erosion" and the next box can be labeled "sediment."

5. When finished, fold each side of the foil over the sediment. Allow a little distance between the shavings and each fold as room for expansion.

- a. What process does the laying down of sediment represent? _____

Part 3: Compaction, Cementation, and Lithification

1. Place your aluminum foil packet on the floor.
2. Compress the packet by carefully standing on it.
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2. Place the boat on a warm hotplate. **CAUTION: HEAT!** Watch as the heat melts the crayon.
3. Remove the foil when the wax is soft to the touch (*use the plastic knife, not your fingers to check this*) and the colors have swirled together but not so much that the colors are indistinguishable. Let the wax cool.

- a. How is this process of creating metamorphic rock different from the actual process?


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 6. On the diagram, the final arrow from “metamorphic rock” can be labeled “melting then cooling.”
 7. Add additional arrows across the middle of the diagram to illustrate that any type of rock can turn into any other type of rock. Label the arrows with the processes that caused the transformation.
 8. List two ways that this lab is similar to how the rock cycle works in real life and two ways that it is different.

Similar:

1. _____
2. _____

Different:

1. _____
 2. _____
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Rock Cycle Diagram

