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. Identify and analyze the effects of weathering, erosion, deposition and lithification.
2. Demonstrate the processes of metamorphic, igneous, and sedimentary rock formation.

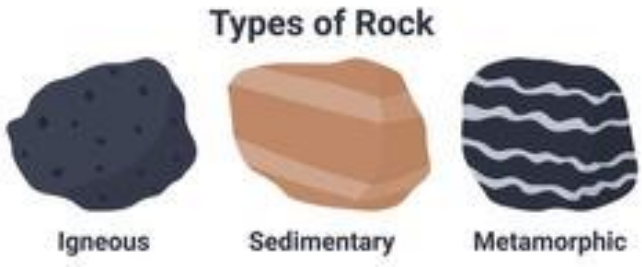
VOCABULARY

Weathering, Erosion, Deposition, Metamorphic, Igneous, Sedimentary

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.



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. What might be the natural weathering forces to cause different size rock fragments? *(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."**

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

EXTENSTION:
For older students, 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.

RESOURCES:
The Rock Cycle

Helpful Hint: For younger students, keep the **labeling of the diagram** in the lesson plan and worksheet. For older students, take the labeling of the diagram out of the worksheet and have students complete at the end for their evaluation.

Name: _____

Modeling the Rock Cycle

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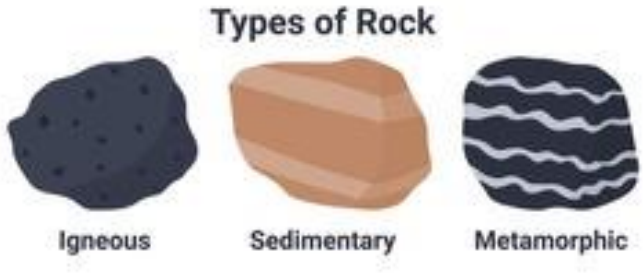

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These processes are often caused by moving water but can also be caused by gravity, wind, and glaciers. Lithification involves the compaction and cementation of sediments to form the rock layers.

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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, 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? _____

    b. What do the shavings represent? _____

    c. What might be the natural weathering forces to cause different size rock fragments? _____

    _____

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? _____

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. What is the difference between the layers now compared to the original layers?

    _____

    _____

    b. Which action occurred to the sediment? _____

    _____
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?

    _____

    _____
4. On the diagram, the arrow from "sedimentary rock" can be labeled "metamorphism—heat and pressure transform 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? _____
3. While it is heating, make a bowl-shape with another piece of aluminum foil and put 3-4 ice cubes in it.
    a. Hypothesis: What will happen once you pour your magma over the ice cubes? _____

    _____
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? _____
    b. Do you see any crystals? _____
    c. Describe the shape and texture. _____

    _____
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."
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.

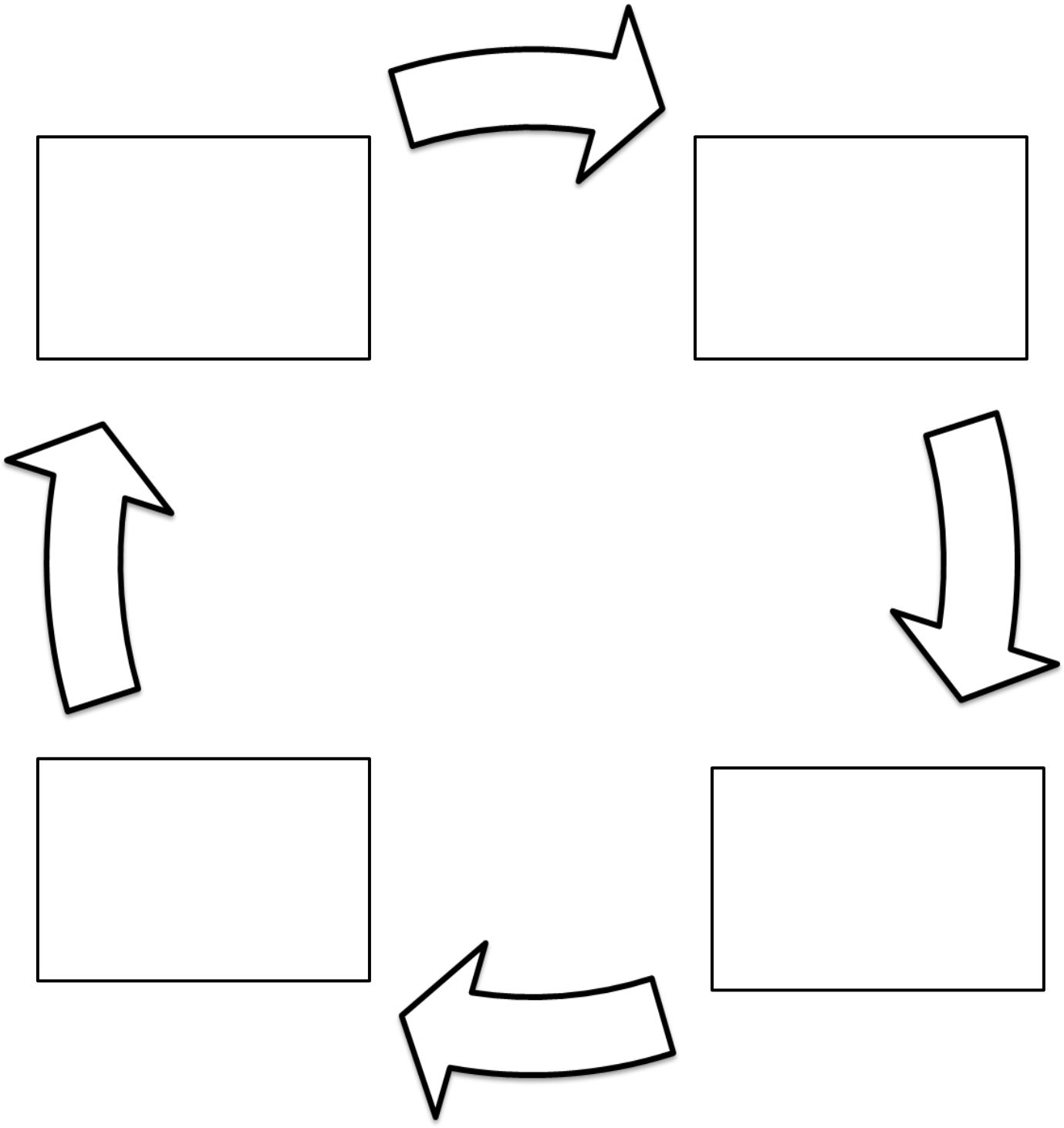
Similar:

1. _____
2. _____

Different:

1. _____
2. _____

ROCK CYCLE



TEKS ADDRESSED:

Science

4th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations
1(B) use scientific practices to plan and conduct descriptive investigations and use engineering practices to design solutions to problems
1(C) demonstrate safe practices and the use of safety equipment during classroom and field investigations as outlined in Texas Education Agency-approved safety standards
1(D) use tools, including hand lenses; metric rulers; Celsius thermometers; calculators; laser pointers; mirrors; digital scales; balances; graduated cylinders; beakers; hot plates; metersticks; magnets; notebooks; timing devices; sieves; materials for building circuits materials to support observation of habitats of organisms such as terrariums, aquariums, and collecting nets; and materials to support digital data collection such as computers, tablets, and cameras, to observe, measure, test, and analyze information
1(E) collect observations and measurements as evidence
1(F) construct appropriate graphic organizers used to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect
1(G) develop and use models to represent phenomena, objects, and processes or design a prototype for a solution to a problem
2(A) identify advantages and limitations of models such as their size, scale, properties, and materials
2(B) analyze data by identifying any significant features, patterns, or sources of error
10(B) model and describe slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice

5th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations
1(B) use scientific practices to plan and conduct descriptive and simple experimental investigations and use engineering practices to design solutions to problems
1(C) demonstrate safe practices and the use of safety equipment during classroom and field investigations as outlined in Texas Education Agency-approved safety standards
1(D) use tools, including calculators, microscopes, hand lenses, metric rulers, Celsius thermometers, prisms, concave and convex lenses, laser pointers, mirrors, digital scales, balances, spring scales, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, notebooks, timing devices, materials for building circuits, materials to support observations of habitats or materials to support digital data collection such as computers, tablets, and cameras to observe, measure, test, and analyze information;
1(E) collect observations and measurements as evidence
1(F) construct appropriate graphic organizers used to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect; and
1(G) develop and use models to represent phenomena, objects, and processes or design a prototype for a solution to a problem.
2(A) identify advantages and limitations of models such as their size, scale, properties, and materials
2(B) analyze data by identifying any significant features, patterns, or sources of error
10(B) model and describe the processes that led to the formation of sedimentary rocks and fossil fuels

6th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations
1(B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems
1(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards
1(D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals
1(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence
1(F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data
1(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems
2(A) identify advantages and limitations of models such as their size, scale, properties, and materials
2(B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations
2(C) use mathematical calculations to assess quantitative relationships in data; and
2(D) evaluate experimental and engineering designs.
10(C) describe how metamorphic, igneous, and sedimentary rocks form and change through geologic processes in the rock cycle

7th Grade

1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations
1(B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems
1(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards
1(D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals
1(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence
2(A) identify advantages and limitations of models such as their size, properties, and materials
2(B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations
2(C) use mathematical calculations to assess quantitative relationships in data
2(D) evaluate experimental and engineering designs.