

THE CRAYON ROCK CYCLE

MATERIALS PER GROUP:

- Crayons (Crayola works best)*
- Plastic knife or penny
- Hot plate
- Aluminum foil
- Foil cupcake liner
- Bacon press or flat heavy object to apply pressure

**Note to Teachers: The crayon wrappers can be difficult to remove. To aid with ease of removal, you can use a razor blade to score the wrappers prior to handing them out.*

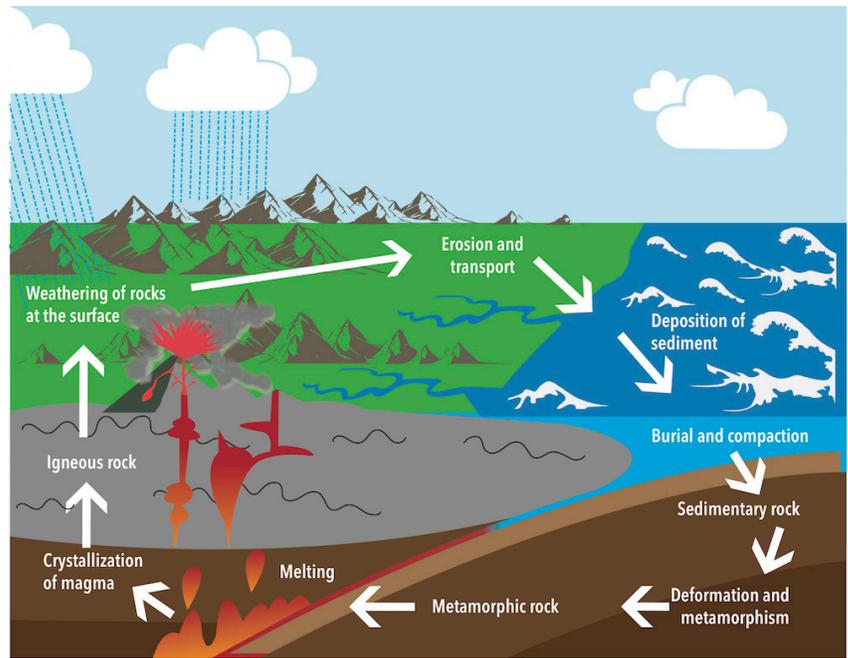
TOTAL DURATION:

15 min. pre-lab prep time; 30-45 min. class time

SAFETY PRECAUTIONS:

- Use extreme care when performing the demonstrations with heat.
- Let hot crayon wax cool completely before handling.

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LESSON OVERVIEW:

Rocks are mixtures of minerals such as quartz, feldspar, mica and calcite. They are the source of all soil mineral material and the origin of all plant nutrients with the exception of nitrogen, hydrogen and carbon. As rock is chemically and physically weathered, eroded and precipitated, it is transformed into soil.

ESSENTIAL QUESTION:

How does matter cycle through Earth's geologic systems?

TOPICAL ESSENTIAL QUESTION:

What is the rock cycle and how are rocks created?

LESSON OBJECTIVES:

Students will be able to:

1. Model the processes involved in the formation of sedimentary, igneous and metamorphic rocks.
2. Investigate the changes rocks undergo during the rock cycle.

STANDARDS:**Middle School**

MS-ESS2-1

Students who demonstrate understanding can:

Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-ESS2-2

Students who demonstrate understanding can:

Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

MS-ESS3-1

Students who demonstrate understanding can:

Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy and groundwater resources are the result of past and current geoscience processes.

High School

HS-ESS2-1

Students who demonstrate understanding can:

Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to

form continental and ocean-floor features.

HS-ESS2-3

Students who demonstrate understanding can:
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

HS-ESS2-5

Students who demonstrate understanding can:
Construct a scientific explanation from evidence for how geological processes lead to uneven distribution of natural resources.

Science and Engineering Practices:

1. Asking questions
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating and communicating evidence

Crosscutting Concepts:

1. Patterns
2. Cause and Effect: Mechanisms and explanations
3. Scale, Proportion and Quantity
4. Systems and System Models
5. Energy and Matter: Flows, cycles and conservation
6. Structure and Function
7. Stability and Change

KEY VOCABULARY:

Lithification

Sediment

Sedimentary rock

Metamorphism

Weathering

Metamorphic rock

Erosion

Magma

Igneous rock

Cementation

Compaction

Rock cycle

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LAB BACKGROUND INFORMATION:

NOTE: This is background information for the teacher to assist in facilitating learning and will be explained to the students after the Explore section.

Soil is one of Earth's most important natural resources. It is the bridge between the living and nonliving worlds and ultimately where most of our food originates. Soil is composed of organic material (humus), water, air and rock (minerals).

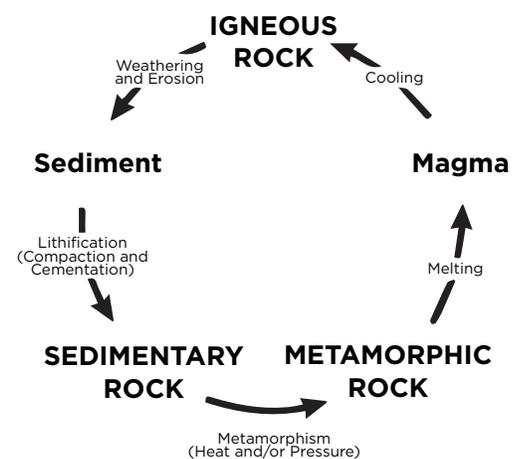
Rocks are mixtures of minerals such as quartz, feldspar, mica and calcite. They are the source of all soil mineral material and the origin of all plant nutrients with the exception of nitrogen, hydrogen and carbon. As rock is chemically and physically weathered, eroded and precipitated, it is transformed into soil.

The **rock cycle** shows how rocks change over time by a variety of physical and chemical processes (see Figure 1). Natural processes that are part of the rock cycle include weathering, erosion, lithification, metamorphism, melting and cooling.

- **Weathering** involves both the chemical and physical breakdown of rock at or near the Earth's surface.
- This results in accumulation of **sediments** – loose materials, such as rock and mineral fragments, or pieces of animal and plant remains that have been transported.
- **Erosion** is the process by which soil and rock are removed from the Earth's surface by forces, such as wind or water flow, and then transported and deposited in other locations.
- **Lithification** is the transformation of sediment into rock. The main processes involved in lithification are:
 - **Cementation** – large sediments are held together by natural cements.
 - **Compaction** – layers of sediments are compressed by the weight of layers above them.
 - **Metamorphism** – the process by which rocks are changed by heat, pressure, shear, stress or chemicals.

Rocks are classified into three distinct groups based on how they are formed:

- **Igneous** rocks are formed by hardened **magma**.
- **Metamorphic** rocks are formed by heat and pressure.
- **Sedimentary** rocks are formed from weathered and cemented pieces of other rocks.



ENGAGE:

Have students bring in rocks they have found to show the class. (This could also be facilitated by having pictures of rocks if samples are not available.)

Discuss the similarities and differences in the rocks. Have students explain why they think the rocks are different.

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Introduction:

This modeling lesson and activity should be part of a larger unit on the rock cycle.

In this activity, crayons will be used to demonstrate the various steps of the rock cycle. Crayons have the ability to be ground into small particles (weathered), heated, cooled and compressed just like rocks. However, unlike rocks, all these processes can be done safely and at reasonable temperatures. Using crayons, you will be able to create sedimentary, metamorphic and igneous crayons (rocks).

EXPLORE:

Create a display showing different types of rocks and ask students to classify them by type. Have students categorize the rock samples or pictures into categories of their own making. Ask students to explain why they grouped them in this way. Use this discussion as an opportunity to introduce the categories of sedimentary, igneous and metamorphic rock, and transition to the rock cycle modeling activity described below.

PROCEDURE:**Activity 1: Make a Sedimentary Crayon Rock**

1. The new crayon may be considered an igneous crayon “rock” because it does not have streaks, layers or grains, all of which are typical of sedimentary or metamorphic rocks.
2. On Figure 2 of the student handout, in the box at the top of the circle, write “igneous rock.”
3. To create sediment, unwrap the crayon and form a pile of shavings on the aluminum foil by scraping the crayon with a knife.

◦ *Note: At this point, ask the students to answer Q1 in the Student Guide.*

• **Q1: What process does shaving the crayon represent? (Sedimentation)**

4. On Figure 2 of the handout, the arrow from “igneous rock” can be labeled “weathering and erosion.” The next box may be labeled “sediment.”

◦ *Note: At this point, ask the students to answer Q2 in the Student Guide.*

• **Q2: What do the crayon shavings represent? (Sediment)**

5. Layer the newly created sediment with sediment from other scraped crayons on a single piece of aluminum foil.
6. Fold the foil over the sediment and press down on the foil (this may be done by stepping on the foil); this process represents lithification – compacting and cementing sediments together.

◦ *Note: At this point, ask the students to answer Q3 in the Student Guide.*

• **Q3: Pressing the rocks together is a process called: (Compaction)**

7. Gently unwrap the foil and observe the new sedimentary crayon. Break the sedimentary crayon “rock” in half and observe the different layers, common in sedimentary rocks.
8. On Figure 2 on the handout, the arrow from “sediment” may be labeled “lithification.” The next box may be labeled “sedimentary rock.”

◦ *Note: At this point, ask the students to answer Q4 in the Student Guide.*

• **Q4: What kind of rock was modeled by pressing the crayon “sediment” together? (Sedimentary)**

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Activity 2: Make a Metamorphic Crayon Rock

1. Fold the foil packet with the sedimentary crayon “rock” shut to seal the packet.
2. Place the closed foil packet on the hot plate and place the bacon press on top of the packet.
3. Remove the foil packet after 5 to 10 seconds (time will depend on temperature of hot plate) and allow the metamorphic crayon “rock” to cool.
4. Once cooled, open the foil packet and observe the metamorphic crayon “rock.”

◦ *Note: At this point, ask the students to answer Q5 and Q6 in the Student Guide.*

• **Q5: What does the equipment used to heat and press the crayon “rock” represent? (Heat and the pressure of the Earth)**

• **Q6: What process(es) must a rock undergo in order to transform into a metamorphic rock? (Heat and/or pressure)**

5. On Figure 2 of the student handout, the arrow from “sedimentary rock” can be labeled “metamorphism,” heat and pressure that transforms the rock. The next box may be labeled “metamorphic rock.”

Activity 3: Make an Igneous Crayon Rock

1. Remove the metamorphic crayon from the foil packet, and break the crayon “rock” into smaller pieces.
2. Place the metamorphic crayon pieces into a foil cupcake liner and place the liner on the hot plate (or float the foil liner on the hot water); melt the crayon until a smooth pool of liquid wax forms and the colors blend together uniformly.
3. Carefully remove the foil, and let the igneous crayon cool.
4. On Figure 2 of the student handout, the final arrow from metamorphic rock may be labeled “melting into magma, then cooling.”

◦ *Note: At this point, ask the students to answer Q7, Q8 and Q9 in the Student Guide.*

• **Q7: What kind of rock was modeled by melting the crayon and letting it cool? (Igneous)**

• **Q8: In nature, what is the source of heat used to form both metamorphic and igneous rock? (Heat from inside the Earth’s crust)**

EXPLAIN: (SEE LAB BACKGROUND)

The Lab Background information from the Teacher Guide is repeated in the Explain section of the Student Guide.

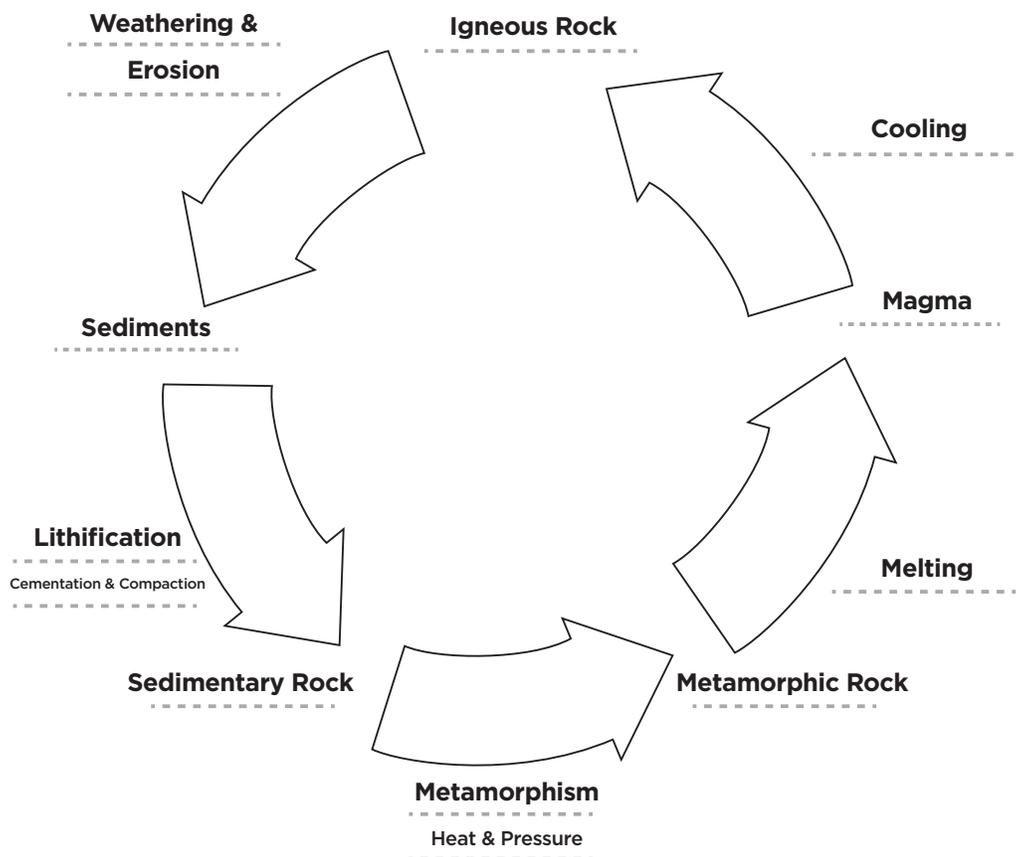
When discussing the rock cycle, it is important to incorporate the fact that soil formation depends on rocks. The weathering and erosion of rock over hundreds, thousands and even millions of years is responsible for creating the soil that we use to grow our food. In addition to the rock, soil also includes air, water, and decaying plant and animal matter (organic matter). The physical and chemical properties of soil are largely a result of the type of rock that it was formed from (parent material). The mineral content of the parent material influences factors such as soil pH, soil color and nutrient content. The type of rock will also influence physical properties such as soil texture and soil structure, which ultimately will influence how that area of land can be used (growing food, holding water, construction of buildings or roads, etc.). Students should recognize that soil is not all the same. In fact, there can be a large variation in soil properties between soils that are mere feet away from each other.

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ELABORATE:**Optional Extension Activities**

- Experiment turning an igneous crayon into a new sedimentary, metamorphic or igneous crayon.
- Try making the following igneous crayon “rocks” (with adult supervision):
 - Melt crayon shavings and pour the melted crayon over small ice cubes to form “pumice.” (<http://en.wikipedia.org/wiki/Pumice>)
 - Melt crayon shavings and pour into ice cold water to form “obsidian.” (<http://en.wikipedia.org/wiki/Obsidian>)
 - Melt crayon shavings and pour into warm water to form “granite.” (<http://en.wikipedia.org/wiki/Granite>)

EVALUATE:**Figure 2. Rock Cycle**

1. What process does shaving the crayon represent?

Weathering

2. What do the crayon shavings represent?

Sediment

3. Pressing the rocks together is a process called:

Sedimentation

4. What kind of rock was modeled by pressing the crayon “sediment” together?

Sedimentary

5. What does the equipment used to heat and press the crayon “rock” represent?

Lithification

6. What process(es) must a rock undergo in order to transform into a metamorphic rock?

Heat and pressure

7. What kind of rock was modeled by completely melting the “metamorphic” crayon rock?

Igneous

8. What kind of rock was modeled by briefly melting the crayon and letting it cool?

Metamorphic

9. In nature, what is the source of heat used to form both metamorphic and igneous rock?

Geothermal heat from the Earth’s core

10. Use the following table to organize your data.

Table 1: Rock Observation and Analysis

Type of Rock	Sedimentary	Metamorphic	Igneous
Process	Lithification	Metamorphism	Melting and Cooling
Appearance	Conglomerate, granular, brown, gray	Colorful, striped, swirled	Crystallized, glassy
Drawing			

B 11. The three major types of rocks are?

- A. Obsidian, granite, sandstone
- B. Igneous, sedimentary, metamorphic
- C. Lithification, erosion, metamorphism
- D. Magma, extrinsic, intrinsic

12. Rocks are mixtures of _____ **minerals** _____ such as quartz, feldspar, mica and calcite.
13. _____ **Weathering** _____ and _____ **erosion** _____ involve both the chemical and physical breakdown of rock at or near the Earth's surface.
14. Is it possible to turn an igneous crayon rock into a sedimentary rock? How?
Yes. Igneous rocks are broken down through weathering and erosion to form sediment. Sedimentary rocks form from this sediment through a process called lithification.
15. Could it be turned directly into a metamorphic rock? How?
Yes. If an igneous rock is subjected to tremendous amounts of heat and pressure from the inside of the Earth, it will bake. In this process, crystals form and the rock composition changes to metamorphic.
16. Could a metamorphic rock be turned directly into a sedimentary rock? How?
Yes. A metamorphic rock can be turned directly into a sedimentary rock if it is broken down through weathering and erosion.
17. Add any additional arrows across the middle of the rock cycle to illustrate that any type of rock can turn into any other type of rock.
Arrows can be added to the image from igneous to sedimentary and metamorphic, from sedimentary to igneous and metamorphic, and from metamorphic to sedimentary and igneous.

This lesson was modified from:

<http://www.exo.net/~emuller/activities/Crayon-Rock-Cycle.pdf>

<http://mjksciteachingideas.com/rocks.html>

Noble Academy would like to thank the following people for their contributions to this lesson:

- Quentin Bidy
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- Fiona McAlister
- Julie Smiley-Foster

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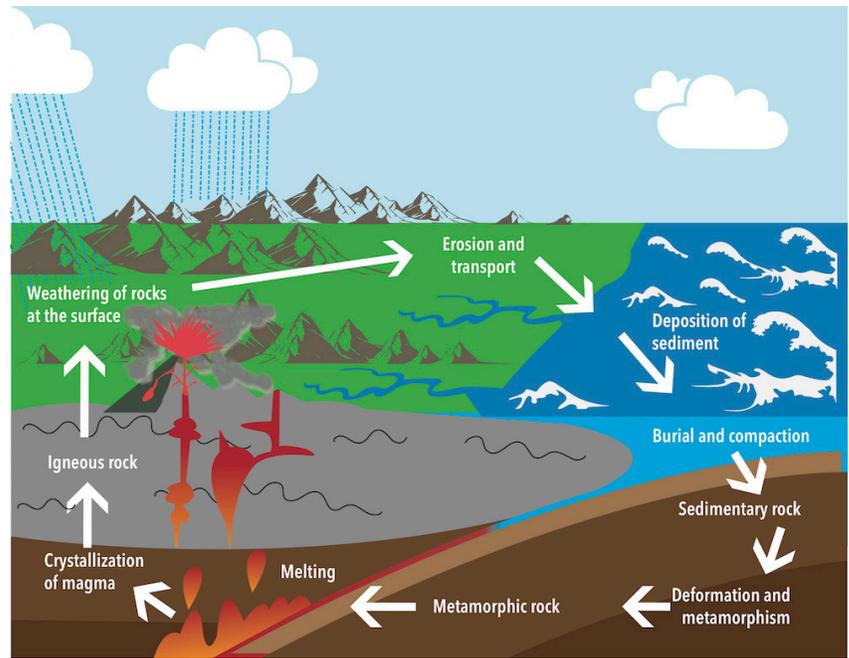
THE CRAYON ROCK CYCLE

MATERIALS PER GROUP:

- Crayons (Crayola works best)*
- Plastic knife or penny
- Hot plate
- Aluminum foil
- Foil cupcake liner
- Bacon press or flat heavy object to apply pressure

SAFETY PRECAUTIONS:

- Use extreme care when performing the demonstrations with heat.
- Let hot crayon wax cool completely before handling.



LESSON OVERVIEW:

Rocks are mixtures of minerals such as quartz, feldspar, mica and calcite. They are the source of all soil mineral material and the origin of all plant nutrients with the exception of nitrogen, hydrogen and carbon. As rock is chemically and physically weathered, eroded and precipitated, it is transformed into soil.

ESSENTIAL QUESTION:

How does matter cycle through Earth's geologic systems?

TOPICAL ESSENTIAL QUESTION:

What is the rock cycle and how are rocks created?

LESSON OBJECTIVES:

You will be able to:

1. Model the processes involved in the formation of sedimentary, igneous and metamorphic rocks.
2. Investigate the changes rocks undergo during the rock cycle.

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INTRODUCTION:

In this activity, crayons will be used to demonstrate the various steps of the rock cycle. Crayons have the ability to be ground into small particles (weathered), heated, cooled and compressed just like rocks. However, unlike rocks, all these processes can be done safely and at reasonable temperatures. Using crayons, you will be able to create sedimentary, metamorphic and igneous crayons (rocks).

ENGAGE:

Look at the different rocks around the classroom. How are they similar? How are they different? Why do you think this is?

EXPLORE:

Create a display showing different types of rocks and classify them by type. Categorize the rock samples or pictures into categories that make sense to you. Explain why you grouped the rocks in this way.

PROCEDURE:

Activity 1: Make a Sedimentary Crayon Rock

1. The new crayon may be considered an igneous crayon “rock” because it does not have streaks, layers or grains, all of which are typical of sedimentary or metamorphic rocks.
2. On Figure 2 of your handout, in the box at the top of the circle, write “igneous rock.”
3. To create sediment, unwrap the crayon and form a pile of shavings on the aluminum foil by scraping the crayon with a knife.
4. On Figure 2 of your handout, the arrow from “igneous rock” can be labeled “weathering and erosion.” The next box may be labeled “sediment.”
5. Layer the newly created sediment with sediment from other scraped crayons on a single piece of aluminum foil.
6. Fold the foil over the sediment and press down on the foil (this may be done by stepping on the foil); this process represents lithification - compacting and cementing sediments together.
7. Gently unwrap the foil and observe the new sedimentary crayon. Break the sedimentary crayon “rock” in half and observe the different layers, common in sedimentary rocks.
8. On Figure 2 of your handout, the arrow from “sediment” may be labeled “lithification.” The next box may be labeled “sedimentary rock.”

Activity 2: Make a Metamorphic Crayon Rock

1. Fold the foil packet with the sedimentary crayon “rock” shut to seal the packet.
2. Place the closed foil packet on the hot plate and place the bacon press on top of the packet.
3. Remove the foil packet after 5 to 10 seconds (time will depend on temperature of hot plate) and allow the metamorphic crayon “rock” to cool.

- Once cooled, open the foil packet and observe the metamorphic crayon “rock.”
- On Figure 2 of your handout, the arrow from “sedimentary rock” can be labeled “metamorphism,” heat and pressure that transforms the rock. The next box may be labeled “metamorphic rock.”

Activity 3: Make an Igneous Crayon Rock

- Remove the metamorphic crayon from the foil packet, and break the crayon “rock” into smaller pieces.
- Place the metamorphic crayon pieces into a foil cupcake liner and place the liner on the hot plate (or float the foil liner on the hot water); melt the crayon until a smooth pool of liquid wax forms and the colors blend together uniformly.
- Carefully remove the foil, and let the igneous crayon cool.
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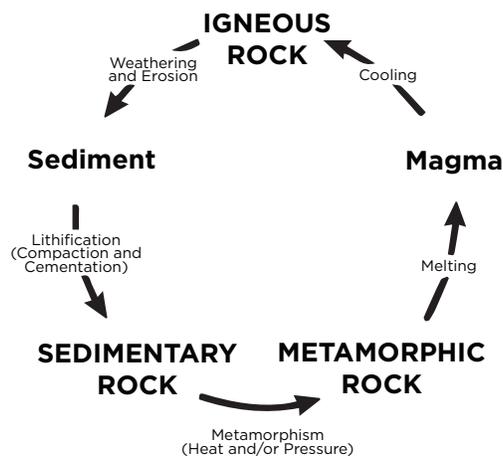
EXPLAIN:

Soil is one of Earth’s most important natural resources. It is the bridge between the living and nonliving worlds and ultimately where most of our food originates. Soil is composed of organic material (humus), water, air and rock (minerals).

Rocks are mixtures of minerals such as quartz, feldspar, mica and calcite. They are the source of all soil mineral material and the origin of all plant nutrients with the exception of nitrogen, hydrogen and carbon. As rock is chemically and physically weathered, eroded and precipitated, it is transformed into soil.

The **rock cycle** shows how rocks change over time by a variety of physical and chemical processes (see Figure 1). Natural processes that are part of the rock cycle include weathering, erosion, lithification, metamorphism, melting and cooling.

- Weathering** involves both the chemical and physical breakdown of rock at or near the Earth’s surface.
- This results in accumulation of **sediments** – loose materials, such as rock and mineral fragments, or pieces of animal and plant remains that have been transported.
- Erosion** is the process by which soil and rock are removed from the Earth’s surface by forces, such as wind or water flow, and then transported and deposited in other locations.
- Lithification** is the transformation of sediment into rock. The main processes involved in lithification are:
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 - Compaction** – layers of sediments are compressed by the weight of layers above them.
 - Metamorphism** – the process by which rocks are changed by heat, pressure, shear, stress or chemicals.



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Rocks are classified into three distinct groups based on how they are formed:

- **Igneous** rocks are formed by hardened **magma**.
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- **Sedimentary** rocks are formed from weathered and cemented pieces of other rocks.

ELABORATE:

Optional Extension Activities

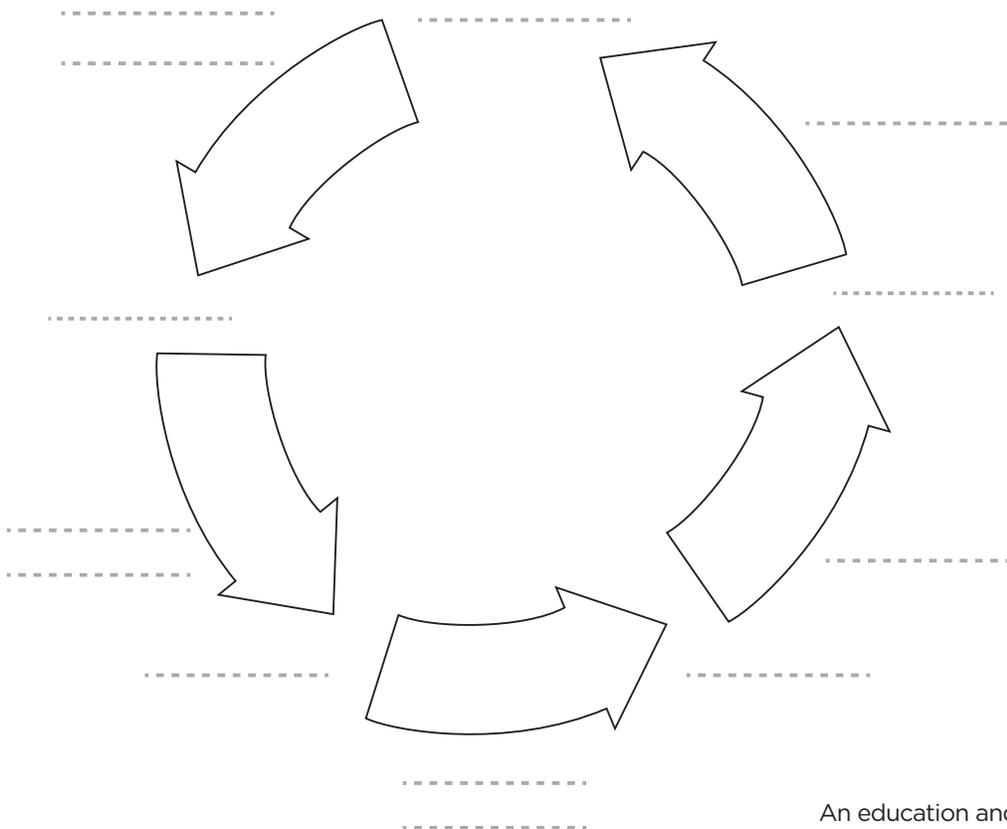
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EVALUATE:

Name: _____

Use knowledge gained from this lesson to complete the questions.

Figure 2. Rock Cycle



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1. What process does shaving the crayon represent? _____
2. What do the crayon shavings represent? _____
3. Pressing the rocks together is a process called: _____
4. What kind of rock was modeled by pressing the crayon "sediment" together?

5. What does the equipment used to heat and press the crayon "rock" represent?

6. What process(es) must a rock undergo in order to transform into a metamorphic rock?

7. What kind of rock was modeled by completely melting the "metamorphic" crayon rock?

8. What kind of rock was modeled by briefly melting the crayon and letting it cool?

9. In nature, what is the source of heat used to form both metamorphic and igneous rock?

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- _____ 11. The three major types of rocks are?
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 - B. Igneous, sedimentary, metamorphic
 - C. Lithification, erosion, metamorphism
 - D. Magma, extrinsic, intrinsic
12. Rocks are mixtures of _____ such as quartz, feldspar, mica and calcite.
13. _____ and _____ involve both the chemical and physical breakdown of rock at or near the Earth's surface.
14. Is it possible to turn an igneous crayon rock into a sedimentary rock? How?
- _____
15. Could it be turned directly into a metamorphic rock? How?
- _____
16. Could a metamorphic rock be turned directly into a sedimentary rock? How?
- _____
17. Add any additional arrows across the middle of the rock cycle to illustrate that any type of rock can turn into any other type of rock.