

Learning Objective: Earth Processes: Matter Cycling and Energy Flowing

NGSS Standard: (MS-ESS2.A) All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

Objective:

Students will be able to:

1. Explain the process of the rock cycle
2. Explain the formation of the different types of rocks in the rock cycle.
3. Explain how matter is cycled throughout Earth in different processes.
4. Identify the energy sources for the cycling of matter.
5. Explain the importance of the Nitrogen cycle.

Time Required: 85 minutes

Materials Needed: ***if materials/time are short, have student work in partners/triads and prepare crayon shavings***

- Crayons (3 different colors per student); crayons should not have any paper covering
- Small manual pencil sharpener (1 per student)
- 2 pieces of aluminum foil per student; 5X5 should suffice (units are inches)
- Hot plate or tea candle
- Student safety goggles
- Tongs
- [Virtual timer](#)
- Earth's Processes Handout (attached)
- Smartboard/document camera/chalkboard/whiteboard
- Mallet or hardcover book (*students will be standing on the book to apply pressure*)

Teacher Preparation:

- Create Playlist 1, a 20 minute [playlist](#) in [Legends of Learning](#) with the following games found in the Earth's Processes: Matter Cycling and Energy Flowing learning objective (in order):
 - *Battle of Wits: Matter Clash*
 - *Memoria: Matter Cycling and Energy Flowing*
- Create Playlist 2, a 15 minute [playlist](#) in Legends of Learning with 5 [assessment questions](#) from the Earth's Processes: Matter Cycling and Energy Flowing learning objective.
- Make copies of the Earth's Processes handout (1 per student)

Engage (20 minutes):

- Each student will need three crayons of different colors.
- Have students use a manual pencil sharpener to sharpen crayons.

Students should collect the crayon shavings in a piece of aluminum foil.

- If time is short, the teacher may sharpen the crayons and pass out the crayon shavings to the class, or the students can sharpen the crayons during another class period when they have finished their work.
- The teacher should ask, "Which of Earth's processes are we modeling by shaving the crayons?"
 - ANSWER: The students are modeling weathering as they break down the crayons.

Sedimentary Rock Model

- The students need to cover the crayon shavings with the other piece of foil paper.
- Using their hands and body weight, the students will need to press the two pieces of aluminum foil together. (*The crayon shavings are in between the two pieces of the aluminum foil*).
- The teacher should ask, "Which Earth process is being modeled by the pressing the pieces of aluminum foil together?" (ANSWER: The students are modeling pressure.)
- The students should remove the top piece of aluminum foil and make observations in their science notebook/journal. (Teacher note: This models the formation of sedimentary rock).
 - What do the students notice about the sedimentary rock? They should notice that the "rock" is still easily crumbled/manipulated.

Metamorphic Rock Model

- Students place the second piece of aluminum foil back over the crayon shavings.
- Using a mallet or by placing the aluminum foil under a hardcover book and standing on it, the students should apply additional pressure to the foil paper/crayon shavings.
- The students should remove the top piece of aluminum foil and make observations in their science notebook/journal. (Teacher note: This models the formation of metamorphic rock).
 - What do the students notice about the metamorphic rock? They should notice that the "rock" colors are more compressed and blended. They also form more of a solid clump than the easily crumbled sedimentary rock.

Igneous Rock Model

- Students need to fold up the sides of their aluminum foil, so that the crayon shavings are contained within the aluminum container.
- For the next part, since heat is being utilized, students must wear safety goggles. The teacher can use a tea candle or allow the students to use hot plates.
- The students are to use tongs to handle their pieces of aluminum foil as they heat up the crayon shavings. Make sure the students are continually moving the aluminum foil back and forth over the heat source to evenly

distribute heat and prevent scorching the foil.

- Use the virtual timer and allow only three minutes for heat to be applied. If students are working alone or in pairs, the teacher should monitor each student/pair of students to ensure safety procedures are being followed.
- Once the heat has been applied, and the crayon shavings have been allowed to cool, the students should make observations in their science notebook/journal. (Teacher note: When heat is added, the formation of igneous rock is being modeled.)
 - What do the students notice about the igneous rock? They should notice that it was liquid then cooled to a solid. The rock is smoother than the other two rocks and the colors have, potentially, blended.
- The teacher should state, "We have just modeled the rock cycle. In today's lesson, we will learn about Earth's processes and the energy that is required to sustain these processes. We will discuss this activity more in depth once you have completed the activities."

Explore (20 minutes):

1. Have your students [sign in to Legends of Learning and enter your teacher code](#).
2. [Launch](#) Playlist 1 to your students.
3. As students complete *Battle of Wits: Matter Clash*, students should fill out the Earth's Processes handout, Parts I and II only. *NOTE: A word bank has been included in the event that some students may need it. It can be removed based on your student's needs.*
4. Assist students as needed during game play, pause playlist if you need to address content or questions to entire class.

Explain (15 minutes):

1. Review answers to Earth's Processes handout by drawing diagrams on the board or using a Smartboard.
2. Relate student knowledge to the demonstration at the beginning of class.
 - a. Which part of the activity at the beginning of the lesson modeled erosion? (The shaving of the crayons).
 - b. Which part of the activity modeled weathering and deposition? (Any time the foil paper and crayon shavings were moved is an example of weathering and deposition; weathering - the moving of the crayon shavings and deposition - the process of placing the crayon shavings in a new location).
 - c. At which point was sedimentary rock modeled? (The original crayon shavings, and the crayon shavings once pressure was applied).
 - d. At which point was metamorphic rock modeled? (The second time pressure was applied to the crayon shavings).
 - e. At which point was igneous rock modeled? (Igneous rock formation was modeled after the crayon shavings were heated and cooled down).
 - f. How is matter cycled? (The rock cycle, the water cycle, plate tectonics, chemical weathering, physical weathering)

- g. How does energy flow on Earth? (Energy from the Sun and Earth's interior cause matter to be cycled).

Elaborate (15 minutes):

1. Matter cycling is important to life on Earth and is not always visible, like a volcano erupting. Sometimes matter is cycled in a way that is not visible to the human eye.
2. This [video](#) explains another process of matter cycling in the Nitrogen cycle.
3. Ask the students why the nitrogen cycle is important.
 - a. ANSWER: Living organisms need nitrogen and are not able to use it in gas form. The nitrogen cycle allows the nitrogen to be fixed into a useable form.
4. Students can answer Part III on the Earth's Processes handout.

Evaluate (15 minutes):

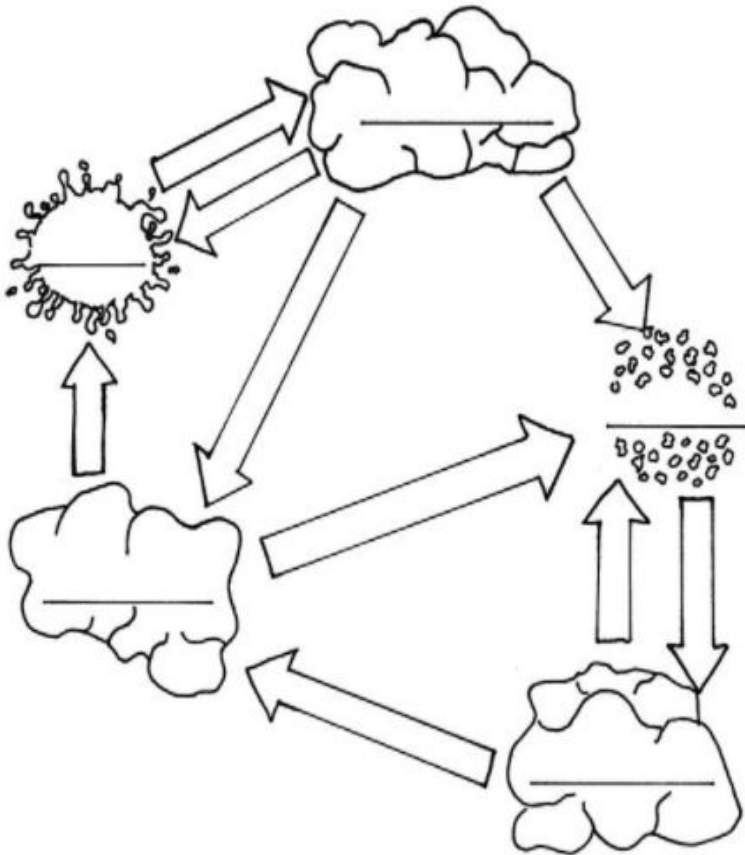
1. [Launch](#) Playlist 2 to your students. When they finish the assessment questions, any time left is freeplay.
2. [Analyze student results](#) to determine what concepts need to be a focus for reteaching.

Earth's Processes

Name: _____

Directions: While playing the first game in Legends of Learning called *Battle of Wits: Matter Clash*, use what you learn to complete the diagrams and answer the questions below.

Part I:



Word Bank (*some words are used more than once*):
 cooling, melting, heat and pressure,
 weathering and erosion, compaction and
 cementation, igneous, metamorphic,
 sedimentary, sediments, magma

Part II: Circle the correct answer.

- Which type of rock is formed from sediments?
 - A** igneous
 - B** metamorphic
 - C** sedimentary
 - D** all of the above

2. Igneous rock comes directly from --
- A** magma
 - B** lava
 - C** sediment
 - D** compaction
3. Which of the following correctly lists Earth's systems?
- A** geosphere, hydrosphere, atmosphere, troposphere
 - B** geosphere, hydrosphere, atmosphere, biosphere
 - C** geosphere, hydrosphere, atmosphere, soil
 - D** geosphere, hydrosphere, atmosphere, mesosphere
4. Which of the following is true about Earth's systems?
- A** Earth's systems change slowly over time.
 - B** Earth's systems change quickly.
 - C** Both A and B are correct
 - D** None of the above
5. Where does the energy that fuels Earth's processes come from?
- A** The Sun
 - B** Earth's interior
 - C** The Sun and Earth's interior
 - D** The Coriolis Effect and the Sun

Part III: In the space provided, explain how matter is cycled and energy flows throughout Earth's systems. Use text and/or illustrations in your explanation.

