

WEATHERING

Weathering Instructional Case: A series of student-centered science lessons

Lesson 2



Suggested Timeline

40 minutes

Materials

- Each Student – copy of Salt & Chalk Mechanical Weathering worksheet
- Set-up for Table Group of four students
- Tray to hold materials
- 1 sandwich or snack size zipper lock bag filled with
 - 1/2 cup salt (regular table salt)
 - 1 piece of colored sidewalk chalk
- Timer (one for each group)

Prep

1. Project copy of the Salt & Chalk Mechanical Weathering worksheet using PowerPoint slide or document camera.
2. Set materials out on a tray for each work group
3. Fill each baggie with about ½ cup of salt
4. Put one piece of colored sidewalk chalk into the salt in the baggie.
5. Make one copy for each student: Salt & Chalk Mechanical Weathering worksheet

Mechanical Weathering-Salt and Chalk Lab

Summary

This lesson includes an activity that models the mechanical weathering of rocks. Students will mechanically “weather” pieces of chalk in ordinary table salt.

Objectives

- Students will create a simple model of mechanical weathering to demonstrate the abrasion process on rock.
- Students will build group process skills and participate in constructive science discourse.
- Students will observe and then reflect on this lab, and be able to express their thinking in a Claim/Evidence/Reasoning format as an exit ticket.

Teacher Background Knowledge

There are two types of weathering processes: chemical and physical weathering. Although chemical and physical weathering work simultaneously and aid one another, it is useful to consider them separately as models. *Chemical weathering* involves the chemical transformation of minerals and commonly results in the dissolution of minerals in a rock. *Physical weathering* (also known as *mechanical weathering*) is the result of physical forces that break rock into smaller and smaller pieces without changing the rock's mineral composition. Although we commonly consider weathering and erosion as separate processes, they occur simultaneously on the Earth's surface and may aid one another. Consider the transport (erosion) of rocks and gravel in a mountain stream where the particles are progressively rounded as they knock against one another and gradually wear down any sharp edges that the particle may have had initially. This activity is analogous to the abrasion (physical weathering) that rocks may experience as they are transported by a variety of environments including rivers, windstorms and glaciers.

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Standards ¹²

NGSS Performance Expectations: <i>This lesson supports students in progressing toward the NGSS Performance Expectation.</i>		
MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.]		
MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]		
Assessment Boundaries: <i>Assessment is limited to the interactions of two systems at a time.</i>		
In this lesson...		
Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
Developing and Using Models Use and/or develop a model of simple systems with uncertain and less predictable factors. Students will develop a model to describe the mechanisms of weathering (both observable and unobservable). The model demonstrates the effects of mechanical weathering with the students acting as the mechanical force. Students then see the degradation of the chalk as it gets abraded with the table salt.	ESS2.A: Earth's Materials and Systems The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. ESS2.C: The Roles of Water in Earth's Surface Processes Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.	Cause and Effect Use cause and effect relationships to predict phenomena in natural or designed systems. Students observe in this investigation the process of mechanical weathering as the pieces of chalk are "weathered" in the table salt. Students then can observe the effects of mechanical weathering using this model.
In this lesson...		
CCSS Mathematics	CCSS English-Language Arts	
n/a	ELA-Literacy.W.6.1 Write arguments to support claims with clear reasons and relevant evidence. Students will be supporting their claims based on evidence from their model.	

¹ NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, D.C.: The National Academies Press.

² National Governors Association Center for Best Practices, Council of Chief State School Officers Title: Common Core State Standards (insert specific content area if you are using only one) Publisher: National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C. Copyright Date: 2010

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Prior Knowledge

In grades 3-5, students have learned that water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.

Students learned in the previous lesson about mountain age and how weathering and erosion contribute to the shape and landscape of the earth's surfaces. Students should have also learned the about the "Claim-Evidence-Reasoning" or C-E-R format. Review safety rules with students; salt should not be eaten, thrown, or put into eyes, etc.

Lesson

1. Set out trays and worksheets
2. Ask students to predict: (Read with students from the worksheet)
"What will happen to a piece of colored sidewalk chalk if we mix it with salt for four minutes? What will happen to the salt? Underline your choices and then explain your answers."
3. Point on the projected copy of the Salt & Chalk Mechanical Weathering worksheet, point to where the students will make their prediction and read with them:
"The chalk will [change shape/change size/stay the same]
The salt will [change color/stay white]"
4. Scan over the class to make sure that they circle a prediction in each statement.
5. Ask students to explain their reasons for choosing that prediction in the "Explain" section.
6. After students are finished with their explanations, start the lab:
 - a. Read the procedures on the worksheet with the students, and check for their understanding and completion.
 - b. Draw a picture on the lab sheet of your chalk's shape in the box titled: Chalk before the experiment.
 - c. Put your piece of chalk into the baggie of salt, and stir carefully with it for 4 minutes making sure that the chalk is mixed throughout the baggie of salt (each student stirs for one minute).
 - d. If you do not have timers for each group, call out one minute time increments, and make sure that students take turns stirring.
 - e. After four minutes, have students STOP.
 - f. Ask student teams to discuss what happened.
 - g. Students may observe a change in the shape of the piece of chalk. If the chalk had sharp edges, they may be more rounded. The most obvious effect of this activity is that as the chalk abrades in the salt, the salt will begin to take on the color of the chalk. This indicates that very small pieces of chalk are mixed in with the salt.
7. Formative Assessment- Students complete the Salt & Chalk Mechanical Weathering worksheet
 - a. Each student writes down observations on their lab sheet under "Observations"
 - b. Each student draws a picture of the chalk in the box titled "Chalk After the Experiment"
8. Analysis of Data: Based on student's data, have students answer the following question:
 - a. What happened to the chalk when it was stirred into salt? Write your answer in C-E-R format:
9. Help students as needed. Ask them to:
 - a. Revisit their prediction and to correct if needed, and then rewrite their claim on the lines on the worksheet.
 - b. Claim: The claim is a statement that sums the important point learned from the experiment.
"The chalk will [change shape/change size/stay the same]"

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The salt will [change color/stay white]"

Sentence stems:

If language support is needed, you may supply the sentence frame:

The chalk will ____ because it will/is....

The salt will ____ because it will/is...

c. Evidence:

Students describe what they saw

Evidence is data from the lab that supports the claim.

d. Reasoning:

Reasoning must explicitly tie the claim and the evidence, and should describe the scientific principles. Reasoning may describe part of the procedure.

10. Create more sentence frames for discussion and writing purposes for after the activity.

11. Extension: Students can design variations of this model and repeat this process. Students can use the model to generate data or test ideas about mechanical weathering.



Delicate Arch Source: National Park Service

Potential Pitfalls

Some misconceptions students may have are that they may think rocks are just the size they are, and don't change in size. Alternatively, they may think that rocks "grow" to get bigger, and "shrink" as they get smaller.

After creating and observing this model activity, students may conclude that weathering is quick and easy, because materials like chalk do abrade and weather so easily, even with salt. In addition, some rocks weather much faster than others, and environmental factors can speed up rates. Make sure that students understand relative timeframes for geologic change as they relate to weathering of rock. Pictures from your textbook may prove helpful (i.e., a gravestone dated from a few hundred years ago may reveal the relative speed of weathering of that type of rock.) Rates of weathering will be addressed in Lesson 3.

Other Resources

What is sidewalk chalk made of? Gypsum (not calcium carbonate)

<http://epod.usra.edu/blog/2009/10/sidewalk-chalk-and-the-calcium-cycle.html>

Summary of Claim-Evidence-Reasoning

<http://www.escofcentralohio.org/Achievement/Documents/Science%20CER%20Handout.pdf>