

WEATHERING

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

Lesson 1



Smokey Mountains
Source: National Park Service

Suggested Timeline

45 minutes

Materials

- Copies of the “Mountain Age” probe found in Vol 1: Uncovering Student Ideas in Science (Keeley, p. 169)
- Copies or e-version of research collection sheet.
- Pictures of local/familiar mountain ranges
- Butcher paper and sticky notes
- Research materials: computers or books on mountain ranges

Preparation

1. One probe per student
2. Print out the research collection sheet OR have students enter information on the electronic version of the document.
3. Write down sentence frames and sentence starters on butcher paper and post in front of classroom.
4. Find pictures and video footage of mountain ranges and place them in sheet protectors for the students to make observations.

Introduction to Weathering

Summary

This lesson is an introduction into a multi-day unit about weathering. In this instructional case, students will learn about the nature of chemical and mechanical weathering and how they affect the surface of our planet and to specifically answer the big questions: “What makes large rocks change into small rocks?”

To introduce concepts of weathering how rocks may change over time --students will share their initial understanding through Page Keeley’s “Mountain Age” formative assessment probe. The student worksheet and teacher background from the probe is included (used with permission). This probe begins the investigation of the weathering of rocks by asking students to consider the results of weathering and erosion on Earth’s surface features such as mountains.

Objectives

- Students demonstrate their prior knowledge on weathering and erosion.
- Students will use reasoning based on prior knowledge or experience with rocks to determine the age of a mountain.

Teacher Background Knowledge

Although this probe does not directly deal with the weathering of rocks, it probes students’ understanding of the role of weathering and erosion on the development of different landscapes. Active mountain building processes are short-term events (millions of years) in geologic time compared to the slower and more gradual weathering and erosion of rocks at the Earth’s surface (hundreds of millions of years). Young mountains tend to have more jagged or irregular shapes due to the uplifting processes that form them. When weathering and erosion outpace mountain building processes, older mountains generally develop a more rounded shape with less topographic relief. Although the weathering and erosion of rocks may seem like ordinary process, their effect over geologic time is very significant and can bring down high mountains. The key to students’ understanding of the role of weathering and erosion in the development of landscapes is the immensity of geologic time.

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Standards ¹²

NGSS Performance Expectations: <i>This lesson supports students in progressing toward the NGSS Performance Expectation.</i>		
<p>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.]</p> <p>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.]</p>		
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
Constructing Explanations and Designing Solutions Students will construct a scientific explanation based on valid and reliable evidence obtained from outside research and the Page Keeley Mountain Age probe reading with the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. Students will use the Claim-Evidence-Reasoning protocol to construct their explanation based on observations and evidence gathered.	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.	Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. Students investigate the age of mountains based on observations and research of mountain elevation, size and area. Students also recognize the role of weathering and erosion when discussing mountain growth.
In this lesson...		
CCSS Mathematics	CCSS English-Language Arts	
n/a	<u>ELA-LITERACY.W.6.1</u> Write arguments to support claims with clear reasons and relevant evidence. <u>CCSS.ELA-LITERACY.RI.6.1</u> Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.	

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 previous grades, students have learned that wind and water change the shape of the land. This probe will determine what their reasoning is based on their prior knowledge or experience of rocks.

It is assumed that students already understand major concepts of the “rock cycle,” and if they do not, the probe may help their misunderstandings surface.

Lesson

1. Administer the probe according to Page Keeley’s Suggestions for Instruction and Assessment. When administering the probe, you can also want to include actual photos of mountains with different ages.
2. This probe will determine what their reasoning is based on their prior knowledge or experience of rocks.

Old Rag Mountain (A)



Source: National Park Service

Mount Everest (B)



Source: National Geographic Photograph by Jodi Cobb

3. Collect the assessments to inform your teaching of the rest of the Weathering unit lessons. You may also have students post their answers on sticky notes and generate a survey of where the class stands (A versus B or A/B are the same age).
4. Introduce pictures of local or familiar mountain ranges. Have a class discussion on nearby mountain ranges and their general observations of mountains. This would be a good time to introduce mountain ranges over time and the geological time scale.

Potential Pitfalls

See Page Keeley’s “Teacher Notes” for possible misconceptions. Note that there is no single correct answer to this probe because shape and height alone cannot be used to determine the age of mountains. Students may reveal that they conceptualize different shaped and sized rocks as just being that way, and have not made connections to the key concept that rocks are part of the Earth’s crust, and have changed over time, chemically and/or mechanically. The probe assesses whether students have considered weathering factors into their claim or if they are basing their reasoning on the belief that taller mountains are older.