Lesson 3

Types of Weathering

Summary

Students will learn about and be able to distinguish between mechanical and chemical weathering, and identify the major factors, which affect rates of weathering.

Note: This is a three-block lesson sequence, each lesson about 45 minutes

Pre-Assessment – Card Sort

Students will organize and classify the vocabulary cards. With very little direction based on their own reasoning. At the end of this lesson sequence, the students will revisit this same model and modify it accordingly.

Block One – Mechanical Weathering

This lesson starts with an informative PowerPoint on mechanical weathering with frequent checks for understanding using student white boards, and ends with creation of a mind map to organize the day’s learning.

Block Two – Chemical Weathering

This lesson starts with students receiving a flavored hard candy to discover a model of chemical and mechanical weathering, and continues with the PowerPoint presentation. Day two ends with students finishing the mind map.

Block Three – Identify Types of Weathering

This lesson starts with a PowerPoint presentation covering factors affecting rates of weathering. Students will then go back to their vocabulary card classification and revise their model based on the information gathered throughout the lesson sequence.

Objective(s)

- Identify five types of mechanical weathering, and five types of chemical weathering
- Identify and recognize the important factors affecting rates of weathering

Materials

- LCD Projector/computer link up to show PowerPoint slides
- Laminated vocabulary cards
- Envelopes or paperclips for laminated cards
- Mechanical and chemical weathering graphic organizers
- One flavored hard candy per student
- One set of laminated photo cards per pair of students
- One student white board and dry erase pen per student

Prep

1. Organize laminated card sort copies in envelopes for each group.
2. Print one mechanical weathering graphic organizer per student
3. Print one chemical weathering graphic organizer per student
4. Print one weathering mind map per student
5. Print off cards using a color printer, then laminate. Prepare one set for every 2-3 students, if possible.

Juniper Pine and Rock Weathering
Source: NASA & Ken DePue
Lesson 3

Types of Weathering

Teacher Background Knowledge

This lesson further describes mechanical and chemical weathering concepts as described in Lesson 2. The card sort is a strategy used specifically for English Learners, but can also be used as a differentiating tool for all of your students. The card sort can be used as a formative assessment tool to have students categorize and classify the cards such that there is a clear reasoning that they can explain to the rest of the class. It is best not to provide a lot of direction and to have the students demonstrate their thinking and in turn, reflect their prior knowledge on the subject. The organization of their card sort can serve as a model that they have developed and then they can revise this same model upon completion of the lesson sequence. The completion of the card sort at the beginning and the end allows students to develop and identify their model as well as practice identifying the types of weathering through visual representations. As you can see in the classifications below, the following cards have been organized in various categories: “living organisms”, “human impact”, “mechanical weathering”, “chemical weathering”, etc. The opportunity to revise their models at the end of the lesson sequence allows students to engage in the practice of modeling where students develop, use, revise, and modify their model to describe abstract phenomena. They can also evaluate the limitations of the model by assessing what cards are missing or invalid based on evidence and new knowledge.
Lesson 3

Types of Weathering

Standards

NGSS Performance Expectations:
This lesson supports students in progressing toward the NGSS Performance Expectation.

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: Assessment is limited to the interactions of two systems at a time.

In this lesson...

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Cross Cutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use and/or develop a model of simple systems with uncertain and less predictable factors. Students will first develop a model to describe abstract phenomena, in this case, they will describe the vocabulary used in the context of weathering and will then revise the model after the culmination of the lesson sequence. Students will also use the model of a flavored hard candy to parallel the different types of weathering with the different ways of consuming the flavored hard candy: chemically or mechanically.</td>
<td>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.</td>
<td>Students develop and use an explicit model to describe weathering and use the model to understand how this system is a part of a larger complex system on Earth. The model of the flavored hard candy and the vocabulary card sort represent the weathering processes. Students also understand that these models are limited and have the opportunity to evaluate the limitations of these models.</td>
</tr>
<tr>
<td></td>
<td>ESS2.C: The Roles of Water in Earth’s Surface Processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations.</td>
<td></td>
</tr>
</tbody>
</table>

In this lesson...

<table>
<thead>
<tr>
<th>CCSS Mathematics</th>
<th>CCSS English-Language Arts</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>CCSS.ELA-LITERACY.RI.6.7</td>
</tr>
<tr>
<td></td>
<td>Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.</td>
</tr>
</tbody>
</table>


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
Lesson 3

Types of Weathering

Prior Knowledge

In grades 3-5, students learned that water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around. Students have also learned that most of Earth’s water is in the ocean and much of the Earth’s fresh water is in glaciers or underground.

In the previous lessons, students have learned about mechanical weathering and the role of weathering and erosion when forming mountains and landscapes.

Lesson

Pre-Assessment:
1. Hand students the vocabulary cards and instruct them to categorize and arrange the cards in a way that makes sense to the group according to the students’ reasoning and prior knowledge.
2. Students can tape the cards on butcher paper or simply arrange them on their tables and take a picture.

Day One:
3. Ask: What is one way that a rock can be broken into a smaller rock?
4. Hand out Mechanical Weathering graphic organizer.
5. Present Part 1 of the Weathering PowerPoint. Instruct students to copy down only the orange-colored text on their graphic organizers. Pause at indicated times to ask students to answer White Board “checking for understanding questions.” Give students one minute to answer the question on their boards, and then ask them to put their boards up all at once. If needed, go back to the relevant slides to re-teach concepts which many students missed.
6. Hand out mind map to each student.
7. Fill in the words on the Mechanical Weathering section of the mind map, with students filling in their sheets.
8. Ask students to draw pictures to illustrate the Mechanical Weathering mind map, using colored pencils.
9. Project the final slide of section 2 to check for understanding. Students will use individual white boards to write answers to questions.
10. Hand out exit card: What were the muddiest parts of today’s lesson for you?

Day 2
11. Give each student one flavored hard candy as they enter the classroom. Tell them they may eat it as they settle into their desks.
12. Ask students to raise their hand if they still have the flavored hard candy in their mouth. Ask students who still have the candy in their mouths what they did differently than the students who finished their candy already. Help students understand that chewing the candy is mechanical weathering, just like they did in the previous Chalk Salt lab in which they weathered a piece of chalk with salt. Explain how sucking on the candy instead of chewing it, which uses saliva to dissolve the candy, is a model for chemical weathering, and the fact that the two types of weathering can occur together to weather a rock (or in this case, a piece of hard candy) faster.
13. Hand out Chemical Weathering graphic organizer.
14. Present the remainder of Section 2 of the Weathering PowerPoint. Instruct students to copy down only the orange-colored text on their graphic organizers. Pause at indicated times to ask students to answer White Board checking for understanding questions. Give students one minute to answer the question on their boards, and then ask them to put their boards up all at once. If needed, go back to the relevant slides to re-teach concepts which many students missed.
Lesson 3  Types of Weathering

15. Fill in the words on the Chemical Weathering section of the mind map, with students filling in their sheets.

16. Ask students to draw pictures to illustrate the Chemical Weathering mind map, using colored pencils.

17. Project the final slide of section 2 to check for understanding. Students will use individual white boards to write answers to questions.

Day 3:

18. Ask: True or False? Living things can cause both chemical and mechanical weathering.

19. Ask students to break into groups of two for guided practice. Give each group the set of laminated vocabulary cards again, which have photos of examples of weathering.

20. Ask student groups to use their notes and mind maps to work together to sort the cards into three categories:

21. Instruct the students to revise their model of the previous card sort. Discuss any pertinent changes, categories, or revisions. Below are some sample categories:

   i. Chemical weathering  
   ii. Mechanical weathering  
   iii. Neither/Not Sure

   *Note: The types of weathering represented in the cards include: ice wedging, animal actions, plant growth, abrasion, oxidation, acid rain, and lichen. Several cards do not represent any kind of weathering.

22. Lead a class discussion of results. The agents of each type of weathering will be written on the board. Examples: Trees, Animals, Wind, Air Pollution, Ice, Sand, Lichen, Acid Rain. Items will be organized into broader categories if possible. Example: Living Things, Chemicals, Water.

23. Ask:

   a. Which of these items can cause both chemical and mechanical weathering?  
   b. Which of these items can only cause chemical weathering?  
   c. Which of these items can only cause mechanical weathering?

24. Present slides from Section 3: Rates of Weathering. Instruct students to copy down only the orange-colored text on their graphic organizers. Pause at indicated times to ask students to answer White Board checking for understanding questions. Give students one minute to answer the question on their boards, and then ask them to put their boards up all at once. If needed, go back to the relevant slides to re-teach concepts which many students missed.

Potential Pitfalls

If LCD is not available to project PowerPoint, use a document camera and print off slides. Alternatively, print slides off on overheads and show using an overhead projector.

Make sure that student partners carefully return all cards.

If you cannot print off example cards, you may show them to the group as a whole, using a projector from the PowerPoint, or a document camera, and then have the class identify the types of weathering they identify.

Make sure that students can access their previous notes and graphic organizers. • Students who finish the card sort early may time each other to see how fast they can get at sorting the cards.

• Students who have trouble sorting the cards should be referred back to their notes.

• If time or materials are limited, you may have students sketch these samples or others from the textbook.