

Earth's Changing Surface

Lesson 5b: Processes That Wear Away Earth's Surface—Weathering

Grade 4	Length of lesson: 40 minutes	Placement of lesson in unit: 5b of 7 two-part lessons on Earth's changing surface
Unit central questions: Why isn't all of Earth's surface flat? What causes the surface to look different in different places?		Lesson focus questions: Can mountains grow so tall they reach outer space? Why or why not?
Main learning goal: <i>Weathering</i> is a process that changes Earth's surface by causing rock to fragment, crack, and crumble into smaller pieces.		
Science content storyline: Mountains on Earth never grow so tall that they reach outer space, because the rock that makes up mountains is continually broken into smaller pieces through a process called <i>weathering</i> . Although plate collision can cause the continual uplift of mountains, the height of a mountain is limited, in part, by weathering.		
Ideal student response to the focus questions: Mountains don't keep getting taller and taller forever, because the rock that forms them is always getting broken down into smaller pieces. Different things can break rock into smaller pieces. Tree and plant roots can grow in the cracks of a rock and break the rock apart. Water in a crack in a rock can expand when it freezes, making the crack get bigger and eventually break the rock apart. Rocks hitting other rocks when they fall or are carried away in fast-flowing streams can also cause rock to break. This breaking-apart process is called <i>weathering</i> .		

Preparation

<p>Materials Needed</p> <ul style="list-style-type: none"> • Science notebooks • Chart paper and markers • <i>For each group of 3–4 students (Task C):</i> <ul style="list-style-type: none"> • Small (16 oz) plastic jugs or tubs with lids (1 per group) • Small bags of lava rocks or other type of rock that breaks apart easily (1 bag per group containing 4–6 rocks) • Paper towels (1 per group) <p>Student Handouts</p> <ul style="list-style-type: none"> • 5.1 Task Directions (1 per student or group) (from lesson 5a) • 5.3 Weathering Processes (for Task C) (1 per student) 	<p>Ahead of Time</p> <ul style="list-style-type: none"> • Review Earth's Changing Surface Content Background Document: sections 7 and 8. • Prepare materials for Task C of the weathering investigation.
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Lesson 5b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
3 min	Link to previous lessons: The teacher reviews science ideas from previous lessons and links them to weathering.	<ul style="list-style-type: none"> • Earth’s thin outer layer (crust) is made up of interlocking tectonic plates that move slowly in different directions. These plates are involved in building up Earth’s surface in various ways. Mountains form when Earth’s crustal plates collide. Plate movements also cause earthquakes and volcanic eruptions. • Tree roots and freezing water can break rocks apart.
1 min	Lesson focus questions: The teacher reviews the focus questions from the previous lesson: <i>Can mountains grow so tall they reach outer space? Why or why not?</i>	
5 min	Setup for activity: The teacher introduces a third task that builds upon the tasks from the previous lesson.	
10 min	Activity: In small groups, students complete a third task that challenges them to think about processes that break apart and wear down mountains and other landforms on Earth’s surface.	<ul style="list-style-type: none"> • Weathering causes rock to break into smaller and smaller pieces.
10 min	Follow-up to activity: The class discusses the handout questions for all three tasks. Then the teacher introduces the concept of weathering.	<ul style="list-style-type: none"> • <i>Weathering</i> is a process that causes rock to fragment, crack, and crumble. As a result, rock is broken into smaller and smaller pieces.
10 min	Synthesize/summarize today’s lesson: Students synthesize ideas from the three tasks in order to answer the focus questions.	<ul style="list-style-type: none"> • Although colliding tectonic plates can cause the continual uplift of mountains, the height of a mountain is limited, in part, by weathering. Weathering can wear down mountains and change the surface of Earth.
1 min	Link to next lesson: The teacher links science ideas to the next lesson and informs students that other forces can wear down landforms on Earth’s surface.	


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3 min	<p>Link to Previous Lessons</p> <p>Synopsis: The teacher reviews science ideas from previous lessons and links them to weathering.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • Earth’s thin outer layer (crust) is made up of interlocking tectonic plates that move slowly in different directions. These plates are involved in building up Earth’s surface in various ways. Mountains form when Earth’s crustal plates collide. Plate movements also cause earthquakes and volcanic eruptions. • Tree roots and freezing water can break rocks apart. 	<p>Link science ideas to other science ideas.</p> <p>Summarize key science ideas.</p>	<p>Show slides 1 and 2.</p> <p>What have we discovered so far about how Earth’s surface changes over time?</p> <p>What evidence did we gather that showed how Earth’s surface is built up?</p> <p>Good examples! We know that volcanic eruptions are one way mountains form. After each eruption, the lava cools into rock that builds up Earth’s surface layer by layer.</p> <p>We also know that mountains form when Earth’s tectonic plates collide. We found evidence for this idea from maps that showed mountain ranges forming at plate boundaries. We also saw evidence that plate collisions cause earthquakes.</p> <p>What did we discover in our last lesson? Did we talk about how Earth’s surface is built up?</p>	<p>We saw pictures of volcanoes and layers of lava building up higher and higher.</p> <p>We used cool maps that showed mountains ranges in the same places where Earth’s plates collide.</p> <p>No, we looked at pictures of how a tree can break a boulder apart.</p>	

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			<p>That's right! Last time, we talked about how trees and freezing water can break rocks apart. So rather than building up Earth's surface, these processes help to wear it down.</p>	<p>And we saw that frozen soda made a can bulge, so maybe it could break rocks apart.</p>	
1 min	<p>Lesson Focus Question</p> <p>Synopsis: The teacher reviews the focus questions from the previous lesson: <i>Can mountains grow so tall they reach outer space? Why or why not?</i></p>	<p>Set the purpose with a <u>focus question</u> or goal statement.</p>	<p>Show slide 3.</p> <p>That leads us to our focus questions for today: <i>Can mountains grow so tall they reach outer space? Why or why not?</i></p> <p>We started thinking about these questions during our last lesson, and we'll continue exploring them in this lesson.</p>		
5 min	<p>Setup for Activity</p> <p>Synopsis: The teacher introduces a third task that builds upon the tasks from the previous lesson.</p>	<p>Make explicit links between science ideas and activities before the activity.</p>	<p>Last time, you worked in small groups to complete two tasks about processes that can break rocks apart. Today, you'll work in the same groups on a third task, and we'll add to the ideas we charted at the end of the previous lesson.</p> <p>For this activity, you'll gather information to help you think about what happens to the rocks on mountains and all over Earth.</p> <p>Then we'll relate all three tasks from our investigation to our focus questions about whether mountains can grow so tall they</p>		

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		<p>Highlight key science ideas and focus question throughout.</p>	<p>reach outer space.</p> <p>NOTE TO TEACHER: <i>Have students gather in the same small groups from the previous lesson and locate handout 5.1 (Task Directions).</i></p> <p>Show slide 4.</p> <p>First, let's review the Task Directions handout. Make sure to follow these directions carefully and keep the focus questions in mind as you work on your task.</p> <p>Today, you'll complete Task C on the handout, so let's go over the directions and review the questions you'll answer in your science notebooks.</p> <p>Remember, your goal is to come up with ideas about whether mountains can keep growing taller and taller until they reach outer space.</p> <p>After this task, your group should (1) review the focus questions, (2) discuss any ideas the task gave you for answering these questions, and (3) write these ideas in your science notebooks using complete sentences.</p> <p>Show slide 5.</p> <p>Follow the directions on the handout to complete the task.</p>		


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			<ol style="list-style-type: none"> 1. Count the rocks in the bag and record the number of rocks in your science notebooks. Then draw a picture of what the rocks look like before you begin the investigation. 2. Place the rocks in the plastic jug, put the lid on the jug, and take turns shaking the jug vigorously for a total of 2 minutes. (It might get a little noisy!) Each group member should shake the jug for about 30 seconds. 3. Pour the rocks onto a paper towel and count them. Record this number in your science notebooks and draw another picture of what the rocks look like after shaking them together. 4. Then answer the two handout questions in your science notebooks. <p>As I walk around the room during the activity, feel free to ask questions if the directions seem unclear.</p> <p>NOTE TO TEACHER: <i>Distribute the materials each group will need to complete Task C.</i></p>		

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10 min	<p>Activity</p> <p>Synopsis: In small groups, students complete a third task that challenges them to think about processes that break apart and wear down mountains and other landforms on Earth’s surface.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Weathering causes rock to break into smaller and smaller pieces. 	<p>Make explicit links between science ideas and activities during the activity.</p> <p>Ask questions to probe student ideas and predictions.</p> <p>Engage students in analyzing and interpreting data and observations.</p>	<p>NOTE TO TEACHER: <i>Continue to display slide 5 throughout the activity. As groups work on Task C, circulate around the room, listening to student ideas, responding to any questions, and probing student thinking when appropriate.</i></p> <p><i>Remind students to observe the rocks carefully before and after they shake the jug. Keep asking students how this task helps them think about the focus questions.</i></p> <p><i>Remind students to write their ideas in their science notebooks and relate the small rocks to boulders rolling down a mountain slope.</i></p>		<p><i>Possible questions to ask during the activity:</i></p> <ul style="list-style-type: none"> Does this give you any ideas about whether mountains can grow so tall they reach outer space? How does this task relate to the tasks from our last lesson?
10 min	<p>Follow-Up to Activity</p> <p>Synopsis: The class discusses the handout questions for all three tasks. Then the teacher introduces the concept of weathering.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> <i>Weathering</i> is a process that causes rock to fragment, crack, and crumble. As a result, rock is broken into smaller and smaller pieces. 	<p>Make explicit links between science ideas and activities after the activity.</p>	<p>Now that you’ve completed Task C, let’s hear some of your observations and ideas from our investigation. What happened to the rocks when you shook the jug? What ideas did you come up with to explain the changes you observed?</p> <p>NOTE TO TEACHER: Keep this share-out brief.</p> <p>Show slide 6.</p> <p>Whole-class discussion: Next, we’ll briefly review the handout questions you answered for each task. Make sure to refer to your handouts and your science notebooks during our discussion.</p>		

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		<p>Highlight key science ideas and focus question throughout.</p> <p>Engage students in using and applying new science ideas in a variety of ways and contexts.</p> <p>Ask questions to</p>	<p>Also keep in mind our focus questions for today: <i>Can mountains grow so tall they reach outer space? Why or why not?</i></p> <p>Task Questions</p> <p>Task A</p> <ol style="list-style-type: none"> 1. Describe what happened to the tree and the boulder between 1999 and 2014. 2. Predict what will happen to the boulder in another 50 years. Explain why you think so. <p>Task B</p> <ol style="list-style-type: none"> 1. Why was the frozen soda can deformed. What do you think will happen to the can when the soda inside thaws? 2. Describe what you think happens over time when water freezes and then thaws in a crack in a rock. <p>Task C</p> <ol style="list-style-type: none"> 1. Describe any differences you notice in how the rocks looked before and after you shook them in the jug. 2. Think about what the rocks in the jug and predict what might happen to a large boulder that rolls down a mountain slope. <p> <i>As students share their ideas, make sure to ask probe questions before asking challenge questions to make sure you</i></p>		

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		<p>probe student ideas and predictions.</p> <p>Ask questions to challenge student thinking.</p>	<p><i>understand their thinking.</i></p> <p>Show slide 7.</p> <p>Did you notice anything these three tasks had in common? Think about what happened or might happen to rocks in each task.</p>	<p>Tasks A and C were about rocks.</p> <p>The rock broke apart in Task A, and it got chipped in Task C.</p> <p>Task B was about a frozen soda can. But one of the questions asked about water freezing in a crack in a rock.</p> <p>It can freeze in a crack in rock.</p> <p>It can break the rock apart.</p>	<p>Can you say anything more about this?</p> <p>What about Task B? Did that task have anything to do with rock?</p> <p>Can rock freeze?</p> <p>What might freezing water do to a crack in a rock?</p> <p>What do you mean by “it”? And what does freezing water do to the rock that is</p>

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		<p>Highlight key science ideas and focus question throughout.</p>	<p>Show slide 8.</p> <p>All three tasks showed different ways that rock can be broken apart or worn down. What are these different ways?</p> <p>Show slide 9.</p> <p><i>Weathering</i> is a process that causes rock to crack, crumble, and break down into smaller and smaller pieces.</p> <p>Write this definition in your science notebooks.</p> <p>NOTE TO TEACHER: <i>Write this definition of weathering—our main learning goal—on chart paper or on the board as well.</i></p> <p>Optional discussion: The word <i>weathering</i> comes from the root word <i>weather</i>. Based on the three tasks we completed, how do you think weathering, or breaking rock into smaller pieces, is related to rock being exposed to the weather? Did anything we do in our tasks relate to weather?</p>	<p>By tree roots.</p> <p>With water freezing in cracks.</p> <p>By rocks bumping against each other.</p> <p>The freezing water in</p>	<p>similar to frozen soda in a can?</p>

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				the crack of a rock had to do with how cold it gets. So that's got something to do with weather.	
10 min	<p>Synthesize/Summarize Today's Lesson</p> <p>Synopsis: Students synthesize ideas from the three tasks in order to answer the focus questions.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Although colliding tectonic plates can cause the continual uplift of mountains, the height of a mountain is limited, in part, by weathering. Weathering can wear down mountains and change the surface of Earth. 	<p>Highlight key science ideas and focus question throughout.</p> <p>Engage students in making connections by synthesizing and summarizing key science ideas.</p>	<p>Show slide 10.</p> <p>Let's turn our attention back to our focus questions: <i>Can mountains grow so tall that they reach outer space? Why or why not?</i></p> <p>NOTE TO TEACHER: <i>Distribute handout 5.3 (Weathering Processes) to each student.</i></p> <p>Small-group discussion: In your small groups, use the images on this handout to brainstorm ideas about how weathering keeps mountains from growing so tall they reach outer space. Make sure to include evidence from the three tasks we completed.</p> <p>NOTE TO TEACHER: <i>Monitor these small-group discussions. After 4 or 5 minutes, have groups share out so that students can hear a variety of ideas before they write their best answers to the focus questions in their science notebooks. During the share-out, add any new ideas to the chart from lesson 5a.</i></p> <p> Embedded Assessment Task</p>		

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			<p>Whole-class share-out: Let’s hear the ideas you came up with in your small groups. How do you think weathering keeps mountains from growing so tall they reach outer space?</p> <p>Show slide 11.</p> <p>Think for a moment about all the great ideas we’ve shared and what we discovered from the three tasks about weathering.</p> <p>Then write your best answers to the focus</p>	<p>Rocks roll down mountains, and that keeps them from getting taller.</p> <p>When a tree grows in a crack in a rock, it can break the rock open, and then the rocks roll down the mountain.</p> <p>Like we saw in the three tasks, trees and freezing water can break rocks apart. That causes rocks to roll down the mountain and keeps the mountain from getting taller.</p>	<p>Say more about how that relates to our focus questions.</p> <p>Does that happen quickly or take a long time? What’s your evidence?</p> <p>That’s an interesting connection. Tell us more about your thinking.</p>

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			<p>questions in your science notebooks. Make sure to use complete sentences and support your ideas with reasoning and evidence.</p>	<p><i>Ideal student response to the focus questions:</i></p> <p>Weathering keeps mountains from growing so tall they reach outer space. The weathering process breaks down rock down into smaller pieces, so even though plate collisions build up mountains, weathering is wearing them down.</p>	
1 min	<p>Link to Next Lesson</p> <p>Synopsis: The teacher links science ideas to the next lesson and informs students that other forces can wear down landforms on Earth’s surface.</p>	<p>Link science ideas to other science ideas.</p>	<p>Show slide 12.</p> <p>Today we learned about weathering and how it can change the surface of Earth by wearing down landforms like mountains.</p> <p>Next time, we’ll investigate other processes that can wear down landforms on Earth’s surface.</p>		