

## Earth's Changing Surface

### Lesson 7a: Many Processes Shape Earth's Surface

<b>Grade 4</b>	<b>Length of lesson:</b> 35 minutes	<b>Placement of lesson in unit:</b> 7a of 7 two-part lessons on Earth's changing surface
<b>Unit central questions:</b> Why isn't all of Earth's surface flat? What causes the surface to look different in different places?		<b>Lesson focus question:</b> How can we use what we've learned about Earth's changing surface to answer the unit central questions?
<b>Main learning goal:</b> Landforms, like mountains and valleys, can be explained using science ideas about plate movement, weathering, and erosion. At any given point in time, Earth's surface is being built up and worn down.		
<b>Science content storyline:</b> Earth's surface is continually being built up and worn down. Plate collisions and volcanic eruptions are building up mountains on Earth's surface. At the same time, weathering and erosion are wearing them down. As plate collisions and volcanic eruptions lift earth materials (like rock) higher, weathering breaks them into smaller pieces, and erosion moves them to lower elevations. Mountain building is still occurring in the western United States, but weathering and erosion are also occurring. Older mountains in the eastern United States have mostly stopped growing, and erosion is wearing them down significantly.		
<b>Ideal student response to the unit central questions:</b> Mountains on Earth's surface are built up in areas where crustal plates collide and push upward (like mountains on the West Coast of the United States). Mountains are also formed where volcanoes erupt. That's why Earth's surface isn't flat everywhere. But even though plate collisions and volcanoes are constantly building up the surface, weathering and erosion are constantly wearing it down. In the middle of Earth's crustal plates, the surface tends to be more flat. But even there, weathering and erosion keep wearing down and changing Earth's surface. As long as the layer of hot rock underneath Earth's crustal plates keeps moving and causing the surface to build up, and as long as water and other forces keep wearing it down, Earth's surface will keep changing and will look different in different places.		

#### Preparation

<p><b>Materials Needed</b></p> <ul style="list-style-type: none"> <li>• Student notebooks</li> <li>• <b>Optional:</b> Chart paper and markers</li> </ul> <p><b>Student Handouts</b></p> <ul style="list-style-type: none"> <li>• 7.1 Building Up and Wearing Down Earth's Surface (1 per student)</li> </ul>	<p><b>Ahead of Time</b></p> <ul style="list-style-type: none"> <li>• Review Earth's Changing Surface Content Background Document: section 9.</li> </ul>
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## Lesson 7a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
3 min	<b>Link to previous lesson:</b> The teacher reviews the focus question from lesson 5: <i>Can mountains grow so tall they reach outer space? Why or why not?</i> Students share their conclusions and ideas about this question.	<ul style="list-style-type: none"> <li><i>Weathering</i> is the process that breaks rock into smaller and smaller pieces, and <i>erosion</i> is the process that transports weathered earth materials from higher elevations to lower elevations. So even though plate collisions and volcanic eruptions are constantly building up Earth's surface, weathering and erosion are constantly wearing it down.</li> </ul>
1 min	<b>Unit central questions and lesson focus question:</b> The teacher reminds students of the unit central questions, <i>Why isn't all of Earth's surface flat? What causes the surface to look different in different places?</i> Then the teacher introduces the focus question, <i>How can we use what we've learned about Earth's changing surface to answer the unit central questions?</i>	
10 min	<b>Setup for activity:</b> The teacher reviews key science ideas about plate collisions and volcanic eruptions related to mountain building, as well as science ideas about weathering, erosion, and deposition.	<ul style="list-style-type: none"> <li><i>Weathering</i> is a process that causes rock to fragment, crack, and crumble over time, often through interactions with water. <i>Erosion</i> is a process in which forces like water or wind transport weathered earth materials from higher elevations to lower elevations over time. <i>Deposition</i> occurs when earth materials are dropped off or deposited in a new location. Although deposition also builds up Earth's surface, plate collisions and volcanic eruptions play the most significant role.</li> <li>Mountain ranges form when Earth's crustal plates collide or when volcanic eruptions release lava that cools and hardens into layers of rock that build up Earth's surface.</li> </ul>
10 min	<b>Activity:</b> Students classify scenarios about processes that build up and wear down Earth's surface. Then they share their answers and reasoning in a class discussion.	<ul style="list-style-type: none"> <li>Plate collisions and volcanic eruptions build up mountains on Earth's surface, and the processes of weathering and erosion wear it down. Deposition also builds up Earth's surface, but not as significantly as plate collisions and volcanic eruptions.</li> </ul>
5 min	<b>Follow-up to activity:</b> Students use everything they've learned so far about Earth's changing surface to answer one of the unit central questions: <i>What causes Earth's surface to look different in different places?</i>	<ul style="list-style-type: none"> <li>At any given point in time, Earth's surface is being built up in some places and worn down in others.</li> </ul>
5 min	<b>Synthesize/summarize today's lesson:</b> In an independent-writing activity, students synthesize their ideas about what builds up and wears down Earth's surface by answering the unit central question, <i>What causes Earth's surface to look different in different places?</i>	<ul style="list-style-type: none"> <li>At any given point in time, Earth's surface is being built up in some places and worn down in others.</li> </ul>
1 min	<b>Link to next lesson:</b> The teacher connects the unit central questions to a use-and-apply task in the final lesson.	

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3 min	<p><b>Link to Previous Lesson</b></p> <p><b>Synopsis:</b> The teacher reviews the focus question from lesson 5: <i>Can mountains grow so tall they reach outer space? Why or why not?</i> Students share their conclusions and ideas about this question.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li><i>Weathering</i> is the process that breaks rock into smaller and smaller pieces, and <i>erosion</i> is the process that transports weathered earth materials from higher elevations to lower elevations. So even though plate collisions and volcanic eruptions are constantly building up Earth's surface, weathering and erosion are constantly wearing it down.</li> </ul>	Link science ideas to other science ideas.	<p><b>Show slides 1 and 2.</b></p> <p>Let's revisit an important focus question we investigated in an earlier lesson: <i>Can mountains grow so tall they reach outer space?</i></p> <p>What did we conclude from our investigations in this unit?</p> <p>What processes did we learn about that wear down mountains?</p> <p>Yes, we learned that weathering breaks rock into smaller and smaller pieces, and through the process of erosion, flowing water in streams and rivers moves those pieces of rock from higher to lower elevations. That's how mountains are continually worn down even though plate collisions and volcanic eruptions are building them up.</p>	<p>Mountains get worn down so they don't keep growing taller and taller.</p> <p>Weathering.</p> <p>Erosion.</p>	
1 min	<p><b>Unit Central Questions and Lesson Focus Question</b></p> <p><b>Synopsis:</b> The teacher reminds students of the unit central questions, <i>Why isn't all of Earth's surface flat? What causes the surface to look different in different places?</i> Then the teacher</p>	Set the purpose with a <u>focus question</u> or goal statement.	<p><b>Show slide 3.</b></p> <p>In this lesson, we'll continue our investigation of Earth's changing surface by connecting the science ideas we've been learning about to our unit central questions, <i>Why isn't all of Earth's surface flat? What causes the surface to look different in different places?</i></p>		

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	introduces the focus question, <i>How can we use what we've learned about Earth's changing surface to answer the unit central questions?</i>		<p><b>Show slide 4.</b></p> <p>Our focus question for today is <i>How can we use what we've learned about Earth's changing surface to answer the unit central questions?</i></p> <p>Take a moment to write the focus question in your science notebooks and draw a box around it.</p> <p><b>NOTE TO TEACHER:</b> <i>Refer to the unit central questions and write the lesson focus question on the board for students to refer to throughout the lesson.</i></p>		
10 min	<p><b>Setup for Activity</b></p> <p><b>Synopsis:</b> The teacher reviews key science ideas about plate collisions and volcanic eruptions related to mountain building, as well as science ideas about weathering, erosion, and deposition.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li><i>Weathering</i> is a process that causes rock to fragment, crack, and crumble over time, often through interactions with water. <i>Erosion</i> is a process in which forces like water or wind transport weathered earth materials from higher elevations to</li> </ul>	<p>Engage students in making connections by synthesizing and summarizing key science ideas.</p> <p>Engage students in</p>	<p><b>Show slide 5.</b></p> <p>To help us answer these important unit central questions, let's first review what we've discovered about Earth's changing surface in this unit.</p> <p>During the last few lessons, we focused on weathering and erosion. What is the difference between these two processes?</p> <p><b>Turn and Talk:</b> Discuss this question with a partner and raise your hand as soon as you have an answer. I'll wait until I see most hands up before calling on a few of you to share your ideas one at a time.</p> <p><b>Show slide 6.</b></p> <p><b>Whole-class share-out:</b> OK, let's hear your ideas about the difference between</p>		

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	<p>lower elevations over time. <i>Deposition</i> occurs when earth materials are dropped off or deposited in a new location. Although deposition also builds up Earth's surface, plate collisions and volcanic eruptions play the most significant role.</p> <ul style="list-style-type: none"> <li>Mountain ranges form when Earth's crustal plates collide or when volcanic eruptions release lava that cools and hardens into layers of rock that build up Earth's surface.</li> </ul>	<p>communicating in scientific ways.</p>	<p>weathering and erosion. As your classmates share their ideas, be ready to agree or disagree, ask question, or add on.</p> <p>So how would you explain the difference between weathering and erosion?</p> <p>Does weathering build up or wear down Earth's surface? Why do you think so?</p> <p>Does erosion build up or wear down Earth's surface? Why do you think so?</p> <p><b>Show slide 7.</b></p> <p><b>Turn and Talk:</b> Now talk with your partner about the difference between erosion and deposition.</p> <p><b>Whole-class share-out:</b> So what's the difference between erosion and deposition?</p>	<p>Weathering is when rock gets broken into smaller bits, and erosion is when water carries the pieces of rock down the mountain.</p> <p>I think other things, like wood and pebbles, can get broken down too. Not just rock.</p> <p>I think wind can cause erosion, not just water.</p> <p>Erosion is about stuff being carried away, and deposition is about where the stuff ends up.</p>	<p>Does anyone agree or disagree? Do you have anything to add on?</p> <p>Can anyone else add on?</p> <p>What do you mean</p>

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			<p>We've already agreed that erosion wears down Earth's surface, but what about deposition? Does it build up or wear down Earth's surface? Why do you think so?</p>	<p>Like rocks and sand and soil.</p> <p>Erosion happens at the top of a mountain, and deposition happens at the bottom.</p> <p>Deposition wear down the surface like erosion does.</p> <p>Because stuff gets dropped off, like, at the bottom of a mountain or the bottom of a river.</p> <p>I disagree because the stuff that gets dropped off starts piling up, so I think it's building up the surface, not wearing it down.</p>	<p>by "stuff"?</p> <p>Who agrees or disagrees? What can you add to this idea?</p> <p>Why do you think that?</p> <p>Does anyone want to challenge that idea?</p> <p>In our stream models, did anyone observe erosion happening in places other than the top? Did anyone observe deposition happening anywhere other than the bottom?</p>

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			<p>When you think about our stream table or a river running down a hillside, is Earth's surface being built up anywhere?</p> <p>Great discussion! Now let's think back to other science ideas we explored about how Earth's surface is built up. Remember the lessons where we used foam mats and maps to help us think about how mountains form?</p> <p><b>Show slide 8.</b></p>	<p>No. The surface is wearing down because the water is carrying rocks and pebbles and such downhill.</p> <p>I agree. Weathering and erosion are about wearing down Earth's surface.</p> <p>No, it's not wearing down Earth's surface, but it's not building it up either. It's just a pile of stuff that gets dropped off where a river ends.</p> <p>Yeah, but a pile is like a tiny, tiny mountain, so deposition does build up the surface.</p>	<p>Does anyone agree or disagree or have something to add?</p> <p>Is deposition also about wearing down Earth's surface?</p>

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			<p>What processes are involved in forming mountains?</p> <p><b>Turn and Talk:</b> Discuss this question with a partner and be ready to share your ideas with the class.</p> <p><b>Whole-class share-out:</b> So what processes are involved in forming mountains?</p> <p>So plate collisions are one way mountains form. What else can build up Earth's surface?</p> <p>Can you think of anything else that might build up Earth's surface?</p>	<p>The collision of Earth's tectonic plates forms mountains and build up Earth's surface.</p> <p>No, the plates move really slow, so it takes a long, long time to build mountains.</p> <p>Volcanoes.</p> <p>Well, we already talked about deposition. That builds up Earth's surface too, but not like plate collisions and volcanic</p>	<p>What is your evidence?</p> <p>Do mountains form immediately from plate collisions?</p> <p>Tell me more about volcanoes and how they build up Earth's surface.</p>

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		Highlight key science ideas and focus question throughout.	<p><b>Show slide 9.</b></p> <p>Great job, everyone! That’s a very thorough review! Before shifting our focus to the activity for today, let’s highlight some key science ideas:</p> <ol style="list-style-type: none"> <li>1. Water usually causes erosion, but wind can too.</li> <li>2. Weathering and erosion don’t just happen to rock. Anything in the environment can be broken down and carried away through these processes.</li> <li>3. Erosion doesn’t happen only on mountains. It can even happen on flat ground!</li> <li>4. Erosion wears down landforms in one area, while deposition builds up landforms in another area.</li> <li>5. Mountain ranges form where Earth’s crustal plates collide. This is one way Earth’s surface is built up.</li> <li>6. Volcanic eruptions also form mountains. When volcanoes erupt, the lava cools and hardens in layers of rock. This is another way Earth’s surface is built up.</li> </ol> <p>So do we agree that all of these processes are involved in building up and wearing down Earth’s surface? Now let’s apply these ideas in an activity.</p>	eruptions do.	
10 min	<b>Activity</b>		<b>Show slide 10.</b>		

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	<p><b>Synopsis:</b> Students classify scenarios about processes that build up and wear down Earth’s surface. Then they share their answers and reasoning in a class discussion.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>• Plate collisions and volcanic eruptions build up mountains on Earth’s surface, and the processes of weathering and erosion wear it down. Deposition also builds up Earth’s surface, but not as significantly as plate collisions and volcanic eruptions.</li> </ul>	<p>Engage students in using and applying new science ideas in a variety of ways and contexts.</p>	<p><b>NOTE TO TEACHER:</b> <i>Distribute handout 7.1 (Building Up and Wearing Down Earth’s Surface) to each student.</i></p> <p>The different scenarios or situations on this handout are examples of ways that Earth’s surface is either built up or worn down.</p> <p>After I read each scenario, you’ll have two decisions to make.</p> <p>First, you need to decide whether the scenario is an example of building up Earth’s surface or wearing it down. Indicate your answer by marking the appropriate box on the handout with an <i>X</i>.</p> <p>Next, you’ll need to decide what is the cause of the scenario. The cause could be plate collisions, volcanic eruptions, weathering, erosion, or deposition.</p> <p>Write the science word or words that describe the cause of the scenario in the right-hand column of the handout.</p> <p>You may choose multiple causes if you think they help explain the scenario.</p> <p>Wait until I read the scenario before you write your answers on the handout. Be prepared to share your reasoning.</p> <p><b>NOTE TO TEACHER:</b> <i>You might consider have students indicate their answers for the first task by using a hand</i></p>		

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		Engage students in communicating in scientific ways.	<p><i>signal—one finger for building up and two fingers for wearing down, for example.</i></p> <p><i>For the cause of each scenario, ask one student to share his or her response and reasoning. Then invite other students to agree, disagree, or add on.</i></p> <p><i>Note that most examples of erosion also involve deposition of the eroded materials in another location, so students can argue effectively that some scenarios involve both erosion and deposition. Similarly, island formation might result from plate collisions and/or volcanic eruptions.</i></p> <p><i>During this discussion, it's most important that students support their answers with evidence and reasoning.</i></p>		
5 min	<p><b>Follow-Up to Activity</b></p> <p><b>Synopsis:</b> Students use everything they've learned so far about Earth's changing surface to answer one of the unit central questions: <i>What causes Earth's surface to look different in different places?</i></p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>At any given point in time, Earth's surface is being built up in some places and worn down in others.</li> </ul>	Make explicit links between science ideas and activities <b>after</b> the activity.	<p>Now look at your completed handout. How many scenarios are about building up Earth's surface, and how many are about wearing it down?</p> <p>We have almost an equal number of Xs in each column, don't we?</p> <p><b>Show slide 11.</b></p> <p>How do you think the ideas about what builds up and wears down Earth's surface apply to our second unit central question: <i>What causes the surface to look different in different places?</i></p>		

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			<p><b>Turn and Talk:</b> Discuss this question with a partner. Be prepared to share your ideas with the class.</p> <p><b>Whole-class share-out:</b> So what are a few of the ideas you came up with for answering this question? Make sure to include evidence from our investigations in this unit.</p>		
5 min	<p><b>Synthesize/Summarize Today's Lesson</b></p> <p><b>Synopsis:</b> In an independent-writing activity, students synthesize their ideas about what builds up and wears down Earth's surface by answering the unit central question, <i>What causes Earth's surface to look different in different places?</i></p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>At any given point in time, Earth's surface is being built up in some places and worn down in others.</li> </ul>	Engage students in making connections by synthesizing and summarizing key science ideas.	<p><b>Show slide 12.</b></p> <p>Before we end today's lesson, complete the sentence on the slide in your science notebooks.</p> <p><i>I think Earth's surface looks different in different places because _____.</i></p> <p>By now, you should have a lot of ideas about how and why Earth's surface builds up and wears down.</p> <p>In your answers, try to use key science ideas about plate collisions, volcanic eruptions, mountain building, weathering, erosion, and deposition. And don't forget to include evidence!</p>		
1 min	<p><b>Link to Next Lesson</b></p> <p><b>Synopsis:</b> The teacher connects the unit central questions to a use-and-apply task in the final lesson.</p>	Link science ideas to other science ideas.	<p><b>Show slide 13.</b></p> <p>In our final lesson, we'll apply everything we've learned so far about Earth's changing surface to a familiar California landform: the San Gabriel Mountains. Then we'll use these science ideas to answer both of our unit central questions.</p>		