

Earth's Changing Surface

Lesson 6b: Processes That Wear Away Earth's Surface

Grade 4	Length of lesson: 50 minutes	Placement of lesson in unit: 6b 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 question: How does flowing water change Earth's surface?
Main learning goal: The processes of erosion and deposition change the surface of Earth by carrying and depositing weathered earth materials, such as rocks and soil, from one place to another.		
Science content storyline: The movement of water in rivers and streams shapes and reshapes Earth's surface by transporting rocks and soil from higher elevations and depositing them at lower elevations. <i>Erosion</i> is the process by which weathered earth materials, such as rock fragments, sand, and soil, are transported from higher elevations to lower elevations. <i>Deposition</i> occurs when earth materials are dropped off or deposited in a new location. Erosion helps wear down higher places, while deposition helps build up lower places.		
Ideal student response to the focus question: Water in rivers and streams moves sand, soil, gravel, and rocks from higher places (like mountains) to lower places. When the water can't carry those materials any farther, they're deposited in streambeds, along the banks of streams and rivers, in lakes, or in the ocean.		

Preparation

<p>Materials Needed</p> <ul style="list-style-type: none"> • Science notebooks • Chart paper and markers <p>Student Handouts</p> <ul style="list-style-type: none"> • 6.1 Stream-Model Observations (from lesson 6a) 	<p>Ahead of Time</p> <ul style="list-style-type: none"> • Review Earth's Changing Surface Content Background Document: sections 7 and 8.
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Lesson 6b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
3 min	Link to previous lesson: The teacher invites students to think about the relationship between weathering and erosion.	<ul style="list-style-type: none"> Weathering can wear down mountains by causing rock to break into smaller and smaller pieces. Erosion also wears down Earth’s surface by transporting weathered earth materials from higher elevations to lower elevations. Flowing water in rivers and streams erodes earth materials, such as sand, soil, gravel, and rocks, and deposits them in new locations.
1 min	Lesson focus question: The teacher reviews the focus question from the previous lesson: <i>How does flowing water change Earth’s surface?</i>	
5 min	Setup for activity: The teacher introduces part 3 of the Stream-Model Observations handout and prepares students to use their data and observations from the stream-table investigation in lesson 6a to answer the handout questions.	<ul style="list-style-type: none"> <i>Erosion</i> is the process by which weathered earth materials are transported from higher elevations to lower elevations. <i>Deposition</i> occurs when earth materials are dropped off or deposited in a new location. Flowing water can cause the erosion and deposition of earth materials like sand, soil, gravel, and rocks.
15 min	Activity: Students complete the independent-writing assignment in part 3 of their Stream-Model Observations handouts. Then they compare ideas in their small groups and prepare to share their ideas with the class.	<ul style="list-style-type: none"> Water in rivers and streams transports weathered earth materials, such as sand, soil, gravel, and rocks, from higher elevations to lower elevations. When the slope of a river or stream isn’t as steep, the water moves more slowly, and earth materials are deposited in streambeds, along the banks of streams and rivers, in lakes, or in the ocean. Models of erosion and deposition can help us understand what happens in the real world.
10 min	Follow-up to activity: Students use their data and observations from the stream model to analyze and interpret the effects of erosion and deposition on Earth’s surface.	<ul style="list-style-type: none"> <i>Erosion</i> is the process by which weathered earth materials, such as rock fragments, sand, and soil, are transported from higher elevations to lower elevations. <i>Deposition</i> occurs when earth materials are dropped off or deposited in a new location. Models of erosion and deposition can help us understand what happens in the real world.
15 min	Synthesize/summarize today’s lesson: Students synthesize ideas about how flowing water changes Earth’s surface. Then they add the concept of weathering to explain why mountains can’t grow so tall they reach outer space.	<ul style="list-style-type: none"> Water can significantly change Earth’s surface through the processes of erosion and deposition. Weathering and erosion wear away the surface of Earth so that mountains can’t grow so tall they reach outer space. <i>Weathering</i> is the process that breaks rock into smaller and smaller pieces, and <i>erosion</i> is the process that transports these earth materials from higher elevations to lower elevations. Even though plate collisions and volcanic eruptions are continually building up mountains, weathering and erosion are constantly wearing them down.
1 min	Link to next lesson: The teacher links science ideas to the next lesson.	

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3 min	<p>Link to Previous Lesson</p> <p>Synopsis: The teacher invites students to think about the relationship between weathering and erosion.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Weathering can wear down mountains by causing rock to break into smaller and smaller pieces. Erosion also wears down Earth's surface by transporting weathered earth materials from higher elevations to lower elevations. Flowing water in rivers and streams erodes earth materials, such as sand, soil, gravel, and rocks, and deposits them in new locations. 	Link science ideas to other science ideas.	<p>Show slides 1 and 2.</p> <p>In today's lesson, we'll analyze our data and observations from the stream models we used last time.</p> <p>But first let's think about how our work with the stream-table model is connected to our previous lessons on weathering and erosion.</p> <p>We've been investigating two focus questions in this lesson sequence:</p> <ol style="list-style-type: none"> Can mountains grow so tall they reach outer space? Why or why not? How does flowing water change Earth's surface? <p>What science ideas did we learn about that answer the first focus question?</p> <p>What do scientists call the process of</p>	<p>Mountains can't reach outer space because rocks get broken down.</p> <p>Tree roots and water freezing in the cracks of mountain rocks can break them apart, and then the rock roll down the mountain.</p>	<p>What do you mean by "rocks get broken down"? How does that happen?</p>

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			<p>breaking rocks into smaller and smaller pieces?</p> <p>Yes, we use the word <i>weathering</i> to describe that process.</p> <p>How do you think the ideas about weathering relate to the second question about flowing water changing Earth's surface?</p> <p>Today we're going to pull together all of these science ideas about weathering, erosion, and deposition and think about how they relate to what happens on Earth's surface.</p>	<p>Weathering.</p> <p>Well, if weathering breaks the rocks down into smaller pieces, then flowing water can carry them away.</p> <p>We saw from our model that water can move small rocks down a stream.</p> <p>I guess not. When it rains really hard, the water sometimes moves small rocks down the street.</p>	<p>Who can add to this idea?</p> <p>Does the water have to be in a stream for it to move rocks or sand?</p>
1 min	<p>Lesson Focus Question</p> <p>Synopsis: The teacher reviews the focus question from the previous lesson: <i>How</i></p>	Set the purpose with a <u>focus question</u> or goal statement.	<p>Show slide 3.</p> <p>Let's review our focus question from last time: <i>How does flowing water change Earth's surface?</i></p>		

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	<i>does flowing water change Earth's surface?</i>		We'll continue exploring this question in this lesson and then analyze our data and observations to help us answer it.		
5 min	<p>Setup for Activity</p> <p>Synopsis: The teacher introduces part 3 of the Stream-Model Observations handout and prepares students to use their data and observations from the stream-table investigation in lesson 6a to answer the handout questions.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> <i>Erosion</i> is the process by which weathered earth materials are transported from higher elevations to lower elevations. <i>Deposition</i> occurs when earth materials are dropped off or deposited in a new location. Flowing water can cause the erosion and deposition of earth materials like sand, soil, gravel, and rocks. 	Make explicit links between science ideas and activities before the activity.	<p>Show slide 4.</p> <p>Take out your science notebooks and your Stream-Model Observations handout from the last lesson. Then locate your data and observations from parts 1 and 2 of the handout.</p> <p>You should have two sets of drawings and written descriptions of erosion and deposition in your stream models—one for part 1 of the handout, and one for part 2 when the stream table was steeper.</p> <p>Show slide 5.</p> <p>Now turn to part 3 of the handout. Notice that the title of this page is “Stream-Table Observations and Reflections.”</p> <p>For today’s investigation, you’ll think like stream scientists. First, you’ll reflect on what happened in your stream models and try to make sense of your data and observations. Then you’ll work independently and in your small groups from last time to answer the questions in part 3 of your handout.</p> <p>Let’s read these questions aloud:</p> <ol style="list-style-type: none"> 1. On your stream table, where were earth materials eroding? 		

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			<ol style="list-style-type: none"> 2. On your stream table, where were earth materials being deposited? 3. How is your stream model like the stream on a mountainside or a stream running down the street after a rainstorm? How is it different? 4. Think about your stream-model observations and answer this question: <i>How does flowing water change Earth's surface?</i> <p>The last question you'll answer also happens to be our lesson focus question.</p>		
15 min	<p>Activity</p> <p>Synopsis: Students complete the independent-writing assignment in part 3 of their Stream-Model Observations handouts. Then they compare ideas in their small groups and prepare to share their ideas with the class.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • Water in rivers and streams transports weathered earth materials, such as sand, soil, gravel, and rocks, from higher elevations to lower elevations. When the slope of a river or stream isn't as 	<p>Engage students in analyzing and interpreting data and observations.</p> <p>Make explicit links between science</p>	<p>Show slide 6.</p> <p>Before you gather in your small groups, review the observations, ideas, and drawings you recorded in your science notebooks last time. Then answer the first three questions in part 3 of your handout.</p> <p>For questions 1 and 2, make sure to include your observations for both the low-angle model and the steep-angle model you used in parts 1 and 2 of the investigation.</p> <p>Individual think time and writing (5 min).</p> <p>Show slide 7.</p> <p>Small groups (10 min): Now split up into your small groups and share your ideas, drawings, and observations from</p>		


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	<p>steep, the water moves more slowly, and earth materials are deposited in streambeds, along the banks of streams and rivers, in lakes, or in the ocean. Models of erosion and deposition can help us understand what happens in the real world.</p>	<p>ideas and activities during the activity.</p>	<p>the stream-model investigation you completed last time. If others share better ideas, you may want to revise your own ideas. Remember, scientists often revise their ideas as they learn new things from other scientists and develop better understandings.</p> <p>After sharing your ideas and observations, discuss your responses to the first three questions in part 3 of the handout. Be ready to share your ideas with the class.</p> <p>For questions 1 and 2, talk about whether you noticed any differences between the low-angle model and the steep-angle model.</p> <p>The first two questions on the handout shouldn't take a lot of time. You should spend most of your time on question 3.</p> <p>NOTE TO TEACHER: <i>As small groups work together on part 3 of the handout, circulate around the room and make sure students are using their written observations and drawings. Ask them to show you the examples of erosion and deposition they observed in their stream models and recorded in their notebooks. (They should have marked in their drawings where they placed their erosion and deposition cards in the stream model.)</i></p> <p><i>Make sure groups move on from questions</i></p>		<p><i>Questions to ask during small-group discussion:</i></p> <ul style="list-style-type: none"> • Where did erosion occur in your stream model? What is your evidence? • What earth materials eroded? Were these materials small or large? • What materials

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			<p><i>1 and 2 fairly quickly and spend most of their time discussing question 3.</i></p>		<p>were harder for the water to erode? Why do you think so?</p> <ul style="list-style-type: none"> • Where did deposition occur? • Which materials were deposited first? Which were deposited last?
10 min	<p>Follow-Up to Activity</p> <p>Synopsis: Students use their data and observations from the stream model to analyze and interpret the effects of erosion and deposition on Earth’s surface.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • <i>Erosion</i> is the process by which weathered earth materials, such as rock fragments, sand, and soil, are transported from higher elevations to lower elevations. <i>Deposition</i> occurs when earth materials are dropped off or deposited in a new location. Models of erosion and deposition can help us understand what happens in the 	Engage students in analyzing and interpreting data and observations.	<p>In our last lesson, I recorded some of your ideas about erosion and deposition on a class chart. Let’s review these ideas and see if we can add to them based on today’s investigation.</p> <p>NOTE TO TEACHER: <i>Briefly review the chart of student ideas about erosion and deposition you created in the previous lesson and add to it during the following discussion.</i></p> <p>Show slide 8.</p> <p>Let’s share some of our ideas and drawings about <i>erosion</i> and <i>deposition</i>.</p> <p>Which earth materials in the stream model were easy for the water to carry away? Why do you think so?</p> <p>Which earth materials were harder for the water to carry away? Why do you think so?</p>	<p>Sand.</p> <p>Little pieces of dirt.</p> <p>Gravel and rocks.</p>	<p><i>Questions to ask during discussion:</i></p> <ul style="list-style-type: none"> • Do you have an idea why this happened? • What is your evidence? • Can you say more about that?

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	real world.		<p>Where were most of the earth materials deposited? Why do you think this happened?</p> <p>Show slide 9.</p> <p>What differences did you notice when the stream-table angle was lower and when it was steeper?</p> <p>How would you explain these differences?</p> <p>How did erosion and deposition change when the angle of the stream table changed?</p> <p>NOTE TO TEACHER: <i>Students will likely say they observed deposition occurring only at the bottom of the stream table. You may need to draw their attention to other areas where deposition occurred. Hopefully they placed their deposition cards in other areas of the model rather than just the bottom.</i></p> <p>When water carries weathered earth materials away, it always flows <i>downhill</i>. When rivers flow downhill into lakes or oceans, do all of the earth materials get deposited where the rivers end?</p>	<p>Most of the earth materials were deposited at the bottom of the stream table because that was as far as the water could carry them.</p> <p>The water ran faster when the angle of the stream table was steeper.</p> <p>More stuff washed away when the angle was steeper.</p>	<p>What do you mean by “more stuff washed away”?</p> <p>What happened to the earth materials when the water flowed slower and faster depending on the angle of the stream table?</p>

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		<p>Highlight key science ideas and focus question throughout.</p>	<p>Show slide 10.</p> <p>On steep mountains, streams or rivers flow downhill so fast that most of the gravel and rocks get carried a long way until they reach a lake or an ocean where they get deposited. But when a stream or river is less steep, the water moves more slowly, and gravel and rocks can be deposited along the banks as well as on the streambed or riverbed.</p> <p>NOTE TO TEACHER: <i>Consider showing different pictures of flowing water, such as a slow-moving river and a gushing mountain waterfall, that illustrate how slope steepness affects erosion and deposition.</i></p> <p>Show slide 11.</p> <p>How is our stream model like a real stream?</p>	<p>No.</p> <p>On the bottom of a river.</p> <p>Along the sides of a river.</p> <p>The water flows downhill.</p> <p>When the angle is steeper, the water runs faster, and more stuff is</p>	<p>Where else can materials like rocks and gravel and sand be deposited?</p> <p><i>Questions to ask during the discussion:</i></p> <ul style="list-style-type: none"> • Can you share some examples? • What is your evidence?

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			<p>How is our model different from a real stream?</p> <p>Where do you think erosion and deposition happen in the streams on this slide?</p>	<p>carried downhill.</p> <p>The water in a real stream carries sand, soil, gravel, and rocks, just like ours did.</p> <p>Stuff gets deposited along the sides and on the bottom of the stream.</p> <p>We don't have a real stream in a classroom!</p> <p>Our model is a lot smaller.</p> <p>We had only one jug of water, and the water ran out.</p> <p>Some fast-moving streams can carry really big rocks. Our stream model couldn't do that.</p>	
15 min	<p>Synthesize/Summarize Today's Lesson</p> <p>Synopsis: Students synthesize ideas about how flowing water changes Earth's surface. Then they add the</p>	Highlight key science ideas and focus question throughout.	<p>Show slide 12.</p> <p>Now let's look at question 4 on the handout: <i>Think about your stream-model observations and answer this question: How does flowing water change Earth's surface?</i></p>		

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			<p>Now let's connect these ideas about building up and wearing down Earth's surface with science ideas from past lessons.</p> <p>How can we add the science idea of weathering to our sentences?</p> <p> <i>Embedded Assessment Task</i></p> <p>Show slide 13.</p> <p>In lesson 5, we talked about how weathering can wear down mountains so they can't reach outer space. Then you wrote in your notebooks your best answer to the focus question, <i>Can mountains grow so tall they reach outer space?</i></p> <p>Review your answers to that question in your science notebooks and your revised sentences about erosion and deposition from today's discussion. Then in one or two complete sentences, write a new best answer to the focus question, <i>Can mountains grow so tall they reach outer space?</i></p> <p>Here's a hint: Start with your revised sentences that describe how flowing water changes Earth's surface and then add the science idea of weathering.</p> <p>NOTE TO TEACHER: <i>An ideal student</i></p>		

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			<p><i>response (see example in column 5) would include a connection between the processes of weathering and erosion as ways that Earth's surface is worn down so mountains can't grow so tall they reach outer space.</i></p> <p><i>Help students understand that weathering causes rocks to break apart, and erosion carries weathered earth materials to lower elevations. Together these ideas help explain why mountains don't just keep getting taller and taller as a result of volcanic eruptions and colliding tectonic plates. Deposition also builds up Earth's surface, but plate collisions and volcanic activity play a more significant role in mountain building.</i></p>	<p><i>Ideal student response: Weathering breaks rock into smaller pieces, and erosion carries those pieces to from higher elevations to lower elevations. So even though plate collisions and volcanic eruptions are constantly building up mountains, weathering and erosion are constantly wearing them down.</i></p>	
1 min	<p>Link to Next Lesson</p> <p>Synopsis: The teacher links science ideas to the next lesson.</p>	<p>Summarize key science ideas.</p> <p>Link science ideas to other science ideas.</p>	<p>Show slide 14.</p> <p>In this unit on Earth's changing surface, we've been exploring how Earth's surface is built up and worn down.</p> <p>Volcanic eruptions, colliding tectonic plates, and even deposits of weathered earth materials are constantly building up Earth's surface. At the same time, weathering and erosion are constantly wearing them down. These processes explain why mountains can't grow so tall they reach outer space.</p> <p>In our next lesson, we'll revisit our unit central questions, <i>Why isn't all of Earth's surface flat? What causes the surface to</i></p>		

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			<p><i>look different in different places? Then you use everything you've learned about Earth's changing surface to answer these questions.</i></p>		