

Earth's Changing Surface Lesson 6: Use and Apply



Grade: 4	Length of lesson: 58 minutes	Placement of lesson: 6 of 6 lessons
Anchoring Phenomenon: The Mississippi delta has grown over thousands of years.		
Unit Learning Goal: At any given point in time, Earth's surface is both building up and wearing down. Some processes build up Earth's surface, while other processes wear down Earth's surface. These processes include weathering, erosion, and deposition and cause Earth's surface to look different in different places.		
Lesson Main Learning Goal: At any given point in time, Earth's surface is both building up and wearing down. Some processes build up Earth's surface, while other processes wear down Earth's surface. These processes include weathering, erosion, and deposition and cause Earth's surface to look different in different places.		
Science and Engineering Practices		
Constructing Explanations		
<ul style="list-style-type: none"> • Construct an explanation of observed relationships. • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation. 		
Crosscutting Concepts		
Cause and Effect		
<ul style="list-style-type: none"> • Cause and effect relationships are routinely identified, tested, and used to explain change. 		
Stability and Change		
<ul style="list-style-type: none"> • Some systems appear stable, but over long periods of time will eventually change. 		
Unit Central Question: What can cause Earth's surface to look the way it does?	Lesson Focus Question: What can cause Earth's surface to look the way it does?	
Science content storyline: Weathering, erosion, and deposition are earth processes that have effects on many different types of landforms. This is part of the reason that Earth's surface looks different in different places. However, these three processes cannot explain all land changes, which leads us to wonder about other processes.		
Ideal student response to the Lesson Focus Question: Earth's surface looks different in different places because different processes shape the land. Some processes build up Earth's surface, while other processes wear down Earth's surface. We are able to use Earth's processes of weathering, erosion, and deposition to explain some land changes, but not all. We are now curious about new questions that we would like to explore in the future.		

Preparation

MATERIALS NEEDED	AHEAD OF TIME
<p>Teacher Resource</p> <ul style="list-style-type: none">• TE6.1 <i>Earth's Changing Surface—Answer Key</i> <p>Student Handouts</p> <ul style="list-style-type: none">• HO6.1 <i>Earth's Changing Surface</i> (1 per student)• HO6.2 <i>ECS Location Cards</i> (1 set per group) <p>Materials</p> <ul style="list-style-type: none">• chart paper and chart markers	<ul style="list-style-type: none">• Review the information in the <i>Content Background</i> document.• Prepare all handouts.• Make sure the Communicating in Scientific Ways poster is visible and accessible to students.


Lesson 6 General Outline

Time	Phase of lesson	How the science content storyline develops
5 min	Introduction, Focus Question, and Link to previous lessons: Students recall how they used the processes of weathering, erosion, and deposition to explain how the Mississippi delta grew and shrank over time. Teacher reminds students of the Unit Central Question— <i>What can cause Earth’s surface to look the way it does?</i> —and introduces that it will also be the focus question for today’s lesson.	Weathering is a process that causes rock to fragment, crack, and crumble over time. Water plays an important role in weathering. Erosion is the process of moving away weathered earth materials from higher to lower elevations over time. It is often caused by moving water. Erosion wears down Earth’s surface. Deposition occurs when the earth materials are left or deposited in a new location. Deposition of sediments helps build up Earth’s surface.
3 min	Setup for Activity: Teacher explains and assigns the use-and-apply task.	
20 min	Activity: Students record ideas and wonderings about what is causing land changes in four locations, explaining how the land changes are examples of weathering, erosion, deposition, or some other unknown processes.	Some processes build up Earth’s surface, while other processes wear down Earth’s surface. Weathering, erosion, and deposition are ongoing processes that shape the surface of Earth.
15 min	Follow-up to Activity: Students come to consensus about what is happening at each location and identify when they could use weathering, erosion, and/or deposition to explain changes in landforms.	Weathering, erosion, and deposition are earth processes that have effects on different types of landforms. However, these three processes cannot explain all land changes, which leads us to wonder about other processes.
12 min	Summarize and Synthesize: Students return to the Unit Central Question— <i>What can cause Earth’s surface to look the way it does?</i> —to synthesize ideas in a class discussion. Students share new questions they have.	Earth’s surface looks the way it does because different processes shape the land. We are able to use Earth’s processes of weathering, erosion, and deposition to explain some of the land changes, but not all. We are now curious about new questions that we would like to explore in the future.
3 min	Link to Next Lesson: Students add new questions to the DQB. Teacher shares how students could keep exploring their new questions.	


Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
5 min	<p>Introduction and Focus Question</p> <p><u>Synopsis</u>: Students recall how they used the processes of weathering, erosion, and deposition to explain how the Mississippi delta grew and shrank over time. Teacher reminds students of the Unit Central Question—<i>What can cause Earth’s surface to look the way it does?</i>—and introduces that it will also be the focus question for today’s lesson.</p> <p><u>Main Science Ideas</u>: Weathering is a process that causes rock to fragment, crack, and crumble over time. Water plays an important role in weathering.</p> <p>Erosion is the process of moving away weathered earth materials from higher to lower elevations</p>	Link science ideas to other science ideas.	<p>NOTE TO TEACHER: You will notice that the lesson main learning goal and the unit learning goal are the same. This is because this is the final lesson and students have the experiences to meet this goal. The Lesson Focus Question and the Unit Central Question are also the same for similar reasons. Students are now prepared to answer the Unit Central Question that is based on the unit learning goal.</p> <p>Last time, we rewatched the animation of the Mississippi delta from beginning to end and used the ideas of weathering, erosion, and deposition to explain what is happening. Take a moment to reread the explanation you wrote in your notebook last time. What are some of the main science ideas we learned through exploring how Earth’s surface changes at the Mississippi delta? <i>(Pause to give time to read and think.)</i></p> <p>NOTE TO TEACHER: Lead a class discussion around what they have figured out about weathering, erosion, and deposition and how these processes change Earth’s surface. An example dialogue is shown to the right.</p>	<p>The delta grows and shrinks because of weathering, erosion, and deposition.</p> <p>What is the difference between weathering, erosion, and deposition?</p> <p>Weathering is when rock gets broken down into smaller bits, and erosion is when water carries the pieces down the mountain.</p> <p>Does anyone agree or disagree or want to add on?</p>

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	<p>over time. It is often caused by moving water. Erosion wears down Earth’s surface.</p> <p>Deposition occurs when the earth materials are left or deposited in a new location. Deposition of sediments helps build up Earth’s surface.</p>	<p>Highlight key science ideas and focus question throughout.</p>	<p>NOTE TO TEACHER: <i>As students share their ideas, highlight key science ideas by making a list of important ideas on the board or chart paper. The ideas should include the following:</i></p> <ul style="list-style-type: none"> • <i>Weathering breaks down rock and other materials.</i> • <i>Erosion is the process of moving away weathered earth materials. It is often caused by moving water but can also be caused by wind.</i> • <i>Deposition occurs when the earth materials are left or deposited in a new location.</i> • <i>Weathering and erosion cause the land to wear down in one area, while deposition builds up the land in another area.</i> • <i>Rock and soil that has been deposited can be eroded again. Weathering, erosion, and deposition are ongoing processes.</i> 	<p>Deposition is when rock and sediment are deposited in a new place.</p> <p>Larger rocks are broken down to smaller pieces that can be carried away and dropped in another place.</p> <p>Who can say more about how these processes affect the surface of Earth?</p> <p>These processes cause Earth to wear down in one place but build up in another place.</p>

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		Set the purpose with a focus question.	<p><i>Use follow-up probe and challenge questions to surface these ideas from students.</i></p> <p><i>Set the purpose of the lesson by saying, Today we will practice using our new ideas about weathering, erosion, and deposition. Remember our Unit Central Question: What can cause Earth’s surface to look the way it does? This is also our Lesson Focus Question for today as we have completed a number of activities and collected data that can help us answer that question. Today we will pull all our ideas together by looking at maps and land features on Earth’s surface.</i></p> <p>NOTE TO TEACHER: <i>Write the Unit Central Question/Lesson Focus Question on the board for the class to see and refer to throughout the lesson.</i></p>	
3 min	<p>Setup for Activity</p> <p><u>Synopsis:</u> Teacher explains and assigns the use-and-apply task.</p> <p><u>Main science ideas:</u> Some processes build up Earth’s surface, while other processes wear down Earth’s surface. Weathering, erosion, and deposition are ongoing processes that shape the surface of Earth.</p>		<p>Here is our challenge: Using what we learned, now we will answer the question, <i>What can cause Earth’s surface to look the way it does?</i></p> <p>We will examine three different locations on Earth’s surface. Your task will be to think about what is causing Earth’s surface to change in these locations. Use your new ideas of weathering, erosion, and deposition to explain what is happening to the land in these locations.</p> <p>NOTE TO TEACHER: <i>Refer students to the list you just made of important science ideas. Distribute HO6.1 Earth’s Changing Surface to each student. Place HO6.2 ECS Location Cards (Location Cards #1-3) in the center of each group’s table. Students will have time to work individually before engaging in group conversation.</i></p>	


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		<p>Make explicit links between science ideas and activities (before activity).</p>	<p>Before we begin talking in our groups, individually examine these three locations and record your ideas or wonderings in the “Cause” column on your handout. Describe <i>how</i> weathering, erosion, and/or deposition causes the land to change and be prepared to share your thinking.</p> <p>NOTE TO TEACHER: Allow students to work individually and have quiet time to do so. Answer questions students might have about the task but not about science questions they have related to the scenarios.</p> <p> <i>Embedded assessment task: Focus on assessing students' understanding of the first three scenarios. A fourth row is available on HO6.1 to include a local landform example either as part of the activity or as an extension using Location Card #4 in the activity follow-up (see details below).</i></p>	
20 min	<p>Activity</p> <p><u>Synopsis:</u> Students record ideas and wonderings about what is causing land changes in four locations, explaining how the land changes are examples of weathering, erosion,</p>	<p>Engage students in using and applying new science ideas in a variety of ways and contexts.</p>	<p>Now that you have had some time to record your thinking, as a group, discuss what is causing Earth’s surface to change in these locations using what we know about weathering, erosion, and deposition. Remember, we have our Communicating in Scientific Ways chart to help us communicate as scientists. <i>[Point to the poster on the wall and direct students to follow along on their copy in their notebook.]</i> Rows 4 and 5 can help you with ways to <i>share</i> your idea. Row 6 can help you <i>ask</i> questions about someone else’s idea. Rows 7 and 9 on the chart can help you <i>comment</i> on an</p>	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
	<p>deposition, or some other unknown processes.</p> <p><u>Main science ideas continued:</u> Some processes build up Earth’s surface, while other processes wear down Earth’s surface. Weathering, erosion, and deposition are ongoing processes that shape the surface of Earth.</p>	<p>Engage students in communicating in scientific ways.</p> <p>Make explicit links between science ideas and activities (during activity).</p>	<p>idea. As you participate in your group’s discussion, record new ideas and questions on your handout.</p> <p>NOTE TO TEACHER: <i>As students work, look to see what features of the map they are paying attention to. Are they noticing features related to weathering, erosion, or deposition? Are they considering the roles of water, ice, wind, vegetation, or gravity?</i></p> <p><i>Also check to see if you can understand their ideas and wonderings without any clarification. If not, ask questions to probe their thinking and challenge them to clearly explain themselves through their writing.</i></p>	<p>I think in location #2, that the sand piled up to form the sand dunes. How do you think the sand piled up?</p> <p>In location #3, I think the mountain becomes rounder because rock is breaking off. What is that called when rock breaks off? How can that happen? Include these details in your writing.</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
15 min	<p>Follow-up to Activity</p> <p><u>Synopsis:</u> Students come to consensus about what is happening at each location and identify when they could use weathering, erosion, and/or deposition to explain changes in landforms.</p> <p><u>Main science ideas:</u> Weathering, erosion, and deposition are earth processes that have effects on different types of landforms. However, these three processes cannot explain all land changes, which leads us to wonder about other processes.</p>	<p>Engage students in communicating in scientific ways.</p> <p>Make explicit links between science ideas and activities (after activity).</p>	<p>NOTE TO TEACHER: Project the location slides one at a time, calling on different groups to share their ideas. Encourage students to ask questions, challenge, and build on their classmates' ideas. Encourage them to use the CSW sentence stems if they need help.</p> <p>Now that you have had time to discuss each location, let's talk about these land changes and patterns as a whole class. _____, could you share your group's ideas about what is happening in location #1?</p> <p> Listen to students' ideas. Are students considering how weathering, erosion, and deposition may or may not play a role in each scenario? Do students understand that these land changes occur over long periods of time? Challenge students to use the words weathering, erosion, deposition, and cause and effect in their responses.</p> <p><i>Science Content Note: Weathering, erosion, and deposition are ongoing processes that occur together across the surface of Earth. All three processes occur in the locations depicted on the first three location cards. After six lessons, you are looking for evidence that students understand how these processes can explain the formation and location of landforms they see, even if their application of these concepts do not always match full scientific understanding.</i></p>	<p>In location #1, we think that waves hitting the sea cliff caused a hole to form.</p> <p>What caused the hole to form? What is that process called? The waves hitting the rock broke it into smaller pieces. The process of breaking rock is called weathering.</p> <p>What do other groups think? Do you agree? Is there anything you would add?</p> <p>In location #2, we think the sand dunes are formed because the rivers dropped the rocks there.</p> <p>Can you point to the rivers you are referring to? What do we notice about these rivers compared to the Mississippi River? These three rivers right here. But they are a lot smaller than the Mississippi River.</p> <p>What does that make you wonder?</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		<p>Highlight <u>key science ideas</u> and focus question throughout.</p>	<p>NOTE TO TEACHER: Highlight a key idea that students may not yet be putting together: the land can be building up and wearing down at the same time.</p> <p>NOTE TO TEACHER: (optional extension) Weathering, erosion, and deposition are only some of the processes that cause Earth’s surface to change. To help students understand that there are still more processes to uncover, you may choose to add the location #4 card in this follow-up to the activity after the first three locations are discussed. Location #4 is hidden in the PowerPoint presentation. If you choose to do this optional activity, you will want to make this slide visible. Introduce this fourth location by saying something like, We will now add a fourth location card to our table for us to consider. Looking at the map and landforms in this location, what do you notice and wonder? Can we use weathering, erosion, and deposition to explain why the land is shaped this way? Why or why not? (See TE6.1 Earth’s Changing Surface—Answer Key for a sample student response.)</p>	<p>I don’t know if these rivers are big enough to move enough rock and soil to make sand dunes.</p> <p>Let’s look back at our important ideas list to see if there are any science ideas that can help us explain what is happening in location #2.</p> <p><i>(Sample extension dialogue)</i></p> <p>I notice that the mountains are getting taller.</p> <p>How is that similar to or different from the delta location?</p> <p>The delta grew bigger, but that was because rock and soil eroded downhill. Can rock and soil move uphill?</p> <p>What do others think?</p> <p>The water, rock, and soil moved downhill because of gravity. I don’t think enough rock and soil could</p>

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
				<p>move uphill to make a mountain grow taller.</p> <p>What else do you notice or wonder about this location? Why is there a deep ocean trench along the coast? Does it have something to do with the mountain range? Is this the only place in the world like this or are there other places with the same pattern? These are some great questions that we can't explain with what we currently know. While erosion, deposition, and weathering help us explain some earth changes, there is more to investigate so we can better understand what can cause Earth's surface to look the way it does!</p>
12 min	<p>Summarize and Synthesize</p> <p><u>Synopsis:</u> Students return to the Unit Central Question—<i>What can cause Earth's surface to look the way it does?</i>—to synthesize ideas in a class</p>	Engage students in making connections by synthesizing and summarizing key science ideas.	<p>To summarize what we have learned, let's return to our Unit Central Question: <i>What can cause Earth's surface to look the way it does?</i></p> <p>NOTE TO TEACHER: Have students return to ideas they charted at the beginning of the lesson. Have students discuss how their ideas have changed and what they have learned. Offer row 11 of the CSW chart to support students to engage in the discussion.</p>	

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	<p>discussion. Students share new questions they have.</p> <p><u>Main science ideas:</u> Earth’s surface looks the way it does because different processes shape the land. We are able to use Earth’s processes of weathering, erosion, and deposition to explain some of the land changes, but not all. We are now curious about new questions that we would like to explore in the future.</p>		<p>In your science notebook, write your best answer to the Unit Central Question—<i>What can cause Earth’s surface to look the way it does?</i>—including all the ideas we have learned through this unit.</p> <p>NOTE TO TEACHER: Give students individual writing time. This is a good place to assess students on their understanding of the learning goals. See the ideal student response to the Lesson Focus Question (same as the Unit Central Question) on the first page of this lesson.</p> <p> <i>Embedded assessment task</i></p>	
3 min	<p>Link to Next Lesson</p> <p><u>Synopsis:</u> Students add new questions to the DQB. Teacher shares how students could keep exploring their new questions.</p>	Link science ideas to other science ideas (next lesson).	Congratulations on figuring out so many science ideas! Next time, you will use your understanding of Earth’s changing surface on the unit assessment.	


 Transforming Science Education Through Research-Driven Innovation

Earth's Changing Surface

Lesson 6


What can cause Earth's surface to look the way it does?




1

Think Back to Lesson 5

What science ideas did you use in your explanation?

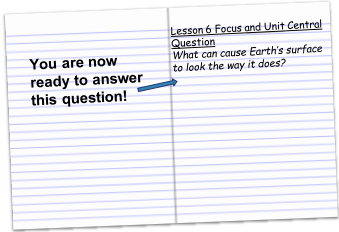





2

Lesson 6 Focus/Unit Central Question

What can cause Earth's surface to look the way it does?





3

Use CSW as You Discuss Your Ideas

Use CSW to *SHARE* your ideas
(rows 4 & 5)

4. Think of an idea that explains your data and observations.

My idea is ...
I predict ... will happen because ...
I think what causes this to ...
I could draw a picture/diagram to show ...

5. Give evidence for your idea or claim.

My evidence is ...
The reason I think that is ...
I think it's true because ...

6. Listen to others' ideas and ask clarifying questions.

Are you saying that ...?
What do you mean when you say ...?
What is your evidence?
Can you say more about ...?

Use CSW to *ASK QUESTIONS*
(row 6)

7. Agree or disagree with others' ideas; add onto someone else's ideas.

I agree/disagree with ... because ...
I want to piggyback on ...'s idea.
I want to add to what ... said.

8. Consider if new ideas make sense.

That idea makes sense to me because ...
That idea doesn't make sense because ...
That idea matches what we saw because ...

Use CSW to *COMMENT* or *RESPOND*
(rows 7 & 9)

4



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Over time, a **sea arch** forms out of a sea cliff.



Hólei Sea Arch (NPS Photo/J. Wie)


Location #1

5



National Parks Service map of Great Sand Dunes National Park (public domain)

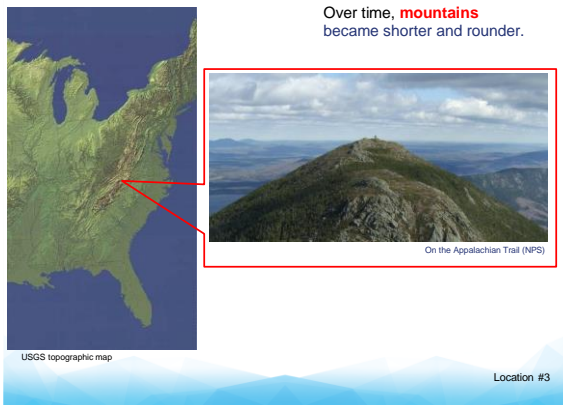
Over time, **sand dunes** form between a windy, sandy area and a mountain range.



Great Sand Dunes National Park, Colorado with the San Juan Mountains visible in the distance. (Credit: Cole Schubert; public domain)

Location #2

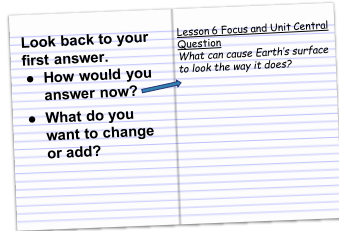
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7

Lesson 6 Focus/Unit Central Question

What can cause Earth's surface to look the way it does?



9

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Earth's Changing Surface

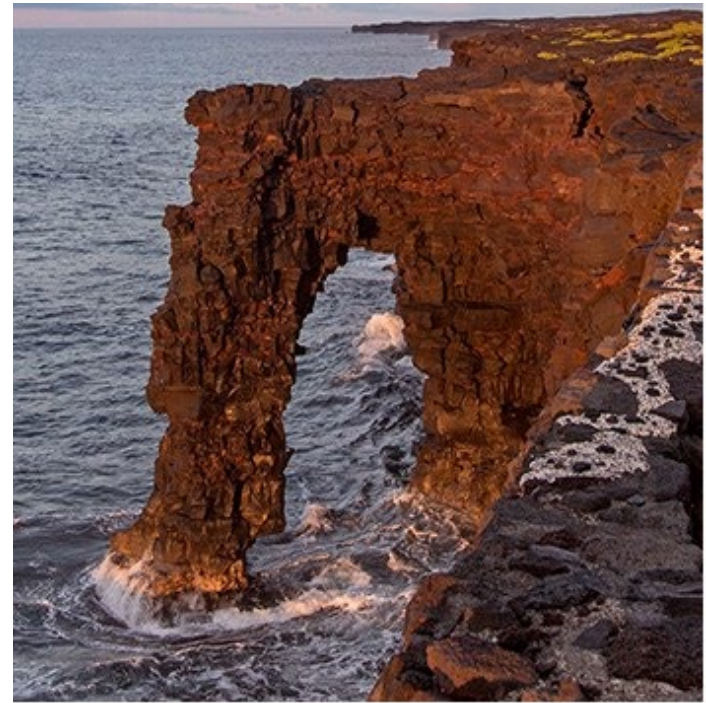
For each location, record your ideas and wonderings about what is *causing* these land changes.

	Cause	Effect
1.		Over time, a sea arch forms out of a sea cliff.
2.		Over time, sand dunes form between a windy, sandy area and a mountain range.
3.		Over time, mountains became shorter and rounder.



Image ©2020 TerraMetrics; map data ©2020

Over time, a **sea arch** forms out of a sea cliff.



Hōlei Sea Arch (NPS Photo/J. Wei)

Over time, **sand dunes** form between a windy, sandy area and a mountain range.



National Parks Service map of Great Sand Dunes National Park



Great Sand Dunes National Park, Colorado with the San Juan Mountains visible in the distance. (Credit: Cole Schubert)

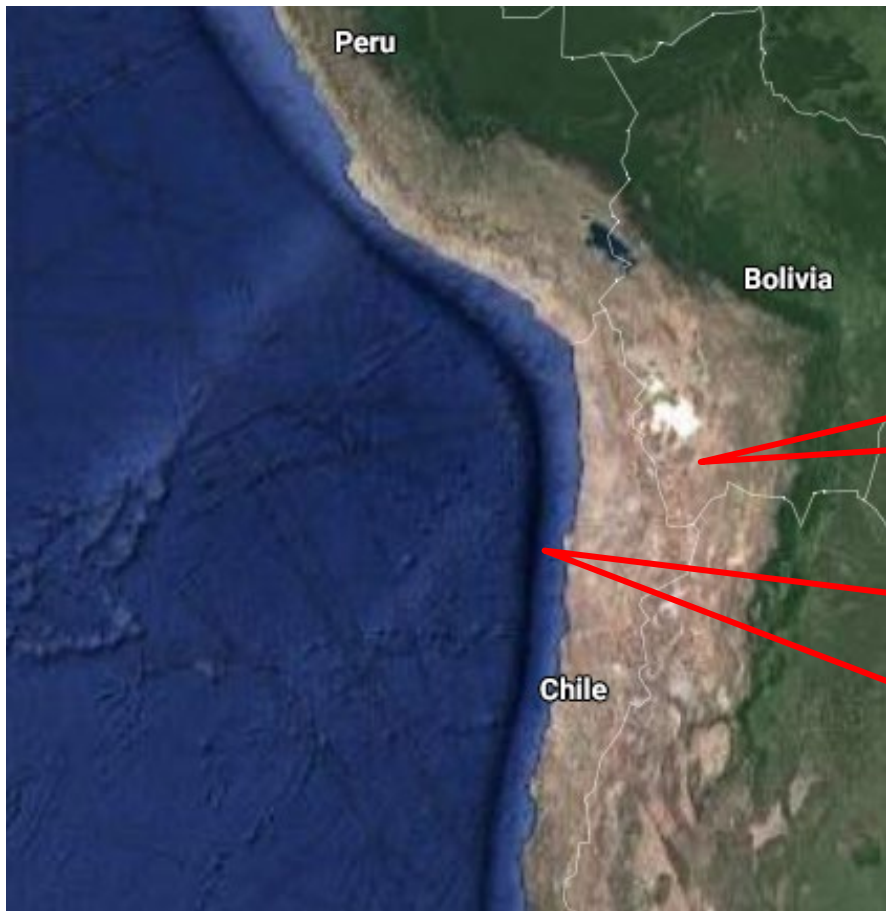
Over time, **mountains** became shorter and rounder.



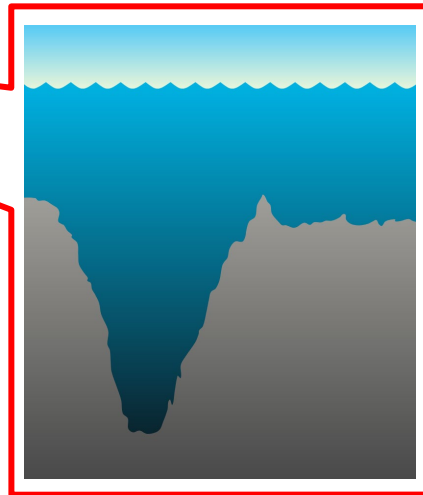
USGS topographic map



On the Appalachian Trail (NPS)



A **mountain range** becomes taller along the coast.



A deep **ocean trench** is found along the coast.

Image ©2020 NASA, TerraMetrics; map data ©2020 Google

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Earth's Changing Surface—Answer Key

For each location, record your ideas and wonderings about what is *causing* these land changes.

	Cause	Effect
1.	A sea arch is caused by weathering and erosion. Overtime, waves hitting the side of a sea cliff cause the rock to break and be carried away. This rock is dropped in the ocean.	Over time, a sea arch forms out of a sea cliff.
2.	These sand dunes are caused by erosion and deposition. Wind carries the sand and deposits it at the bottom of the mountain. Also, water moves sand, rocks, pebbles, and soil from the top of the mountain to the bottom through rivers and streams.	Over time, sand dunes form between a windy, sandy area and mountain range.
3.	Mountains became shorter and rounder because of weathering and erosion. Rain, ice, wind, and plants can break the rock at the top of the mountain. These smaller pieces of rock are then eroded from a higher place and deposited in a lower place.	Over time, mountains became shorter and rounder.
4. optional	In location #4, we wondered if wind and waves could erode and deposit enough rock and sand to make a whole mountain range. Can rock and soil be deposited at the top of a mountain? We learned that water, rock, and soil flow downhill because of gravity. So how can a mountain grow taller? Also, why is there a deep trench along the coast? We think there might be other processes causing Earth's surface to look like this.	A mountain range becomes taller, and a deep ocean trench is found along the coast.

