Earth's Changing Surface
Lesson 4a: Evidence of Plate Collisions

Grade 4	**Length of lesson:** 38 minutes	**Placement of lesson in unit:** 4a 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:** What evidence can we find to support the idea that mountains form when Earth's crustal plates collide?
Main learning goal: Mountains form when Earth's crustal plates move toward each other and collide.		
Science content storyline: Earth's thin outer layer (crust) of cold, rigid rock is made up of interlocking plates, like puzzle pieces, that scientists call *tectonic plates*. Heat from Earth's core softens a thick layer of rock beneath the crust, causing the rock to heat up and rise very slowly toward the surface. Earth's tectonic plates float, or ride, on top of this hot underlying layer of rock, which causes the plates to move in different directions. Plates can move toward each other and collide, move away from each other, or move side to side, sliding past each other. Colliding plates result in the formation of mountain ranges.		
Ideal student response to the focus question: Mountains form when Earth's tectonic plates move toward each other and collide. We can use evidence from a map of Earth's plate boundaries to show where these plates collide and form mountain ranges.		

Preparation

Materials Needed • Student notebooks • Chart paper and markers **Student Handouts** • 4.1 Map of Plate Boundaries around the World (1 for each pair of students and 1 for display)	**Ahead of Time** • Review Earth's Changing Surface Content Background Document: section 6. • Prepare handout 4.1 (Map of Plate Boundaries around the World) for display on a document reader or Smart Board.

Lesson 4a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
3 min	**Link to previous lesson:** The teacher reviews ideas about plate movement and mountain building from previous lessons.	• The plates of Earth's crust can collide and form mountain ranges.
4 min	**Lesson focus question:** The teacher introduces the focus question, *What evidence can we find to support the idea that mountains form when Earth's crustal plates collide?*	
5 min	**Setup for activity:** The teacher links science ideas and models from previous lessons to today's investigation of a world map of plate boundaries to find evidence of mountain building.	• Earth's thin outer layer (crust) is made up of interlocking plates, like puzzle pieces, that scientists call *tectonic plates*. Heat from Earth's core softens a thick layer of rock beneath the crust, causing it to heat up and rise very slowly toward the surface. Earth's tectonic plates float, or ride, on top of this hot underlying layer of rock, which causes the plates to move in different directions.
15 min	**Activity:** Students examine a map of plate boundaries around the world and make predictions about where Earth's crustal plates might collide.	• Earth's tectonic plates move in different directions. They can move toward each other and collide; they can move apart; or they can move side to side, sliding past each other. A world map of plate boundaries provides evidence of collisions that sometimes take place where Earth's plates move toward each other.
5 min	**Follow-up to activity:** Students discuss their predictions about where Earth's tectonic plates might collide and what might happen at these plate boundaries.	• A world map of plate boundaries supports the idea that Earth's tectonic plates move in three basic ways: They move toward each other and collide; they move apart; and they move side to side, sliding past each other. A plate-boundary map also shows where Earth's plates might collide and form mountain ranges.
5 min	**Synthesize/summarize today's lesson:** Students use new information about Earth's crustal plates to synthesize their ideas about how mountains form.	• When Earth's tectonic plates move toward each other and collide, they form mountain ranges**.**
1 min	**Link to next lesson:** The teacher informs students that next time, they'll collect additional data from new maps to support the idea that mountains form where Earth's tectonic plates collide.	

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3 min	**Link to Previous Lesson** **Synopsis:** The teacher reviews ideas about plate movement and mountain building from previous lessons. **Main science idea(s):** • The plates of Earth's crust can collide and form mountain ranges.	Link science ideas to other science ideas. Ask questions to elicit student ideas and predictions.	**Show slides 1 and 2.** Today we'll build on what we learned last time about the movement of tectonic plates that make up Earth's crust. We'll also continue thinking about whether plate collisions are involved in mountain building. Think for a moment about what we've discovered so far about Earth's tectonic plates from our models and investigations. What are your current ideas about what happens when Earth's plates collide? Make sure to support your ideas with evidence. But how do we know for sure that plate collisions cause mountains to form? Today we'll gather more information from scientists who study the movement of Earth's tectonic plates and add to what we already know—or think we know.	When Earth's plates crash into each other, they push up mountain ranges. Models showed us what happens when Earth's plates collide.	What's your evidence to support this idea?

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4 min	**Lesson Focus Question** **Synopsis:** The teacher introduces the focus question, *What evidence can we find to support the idea that mountains form when Earth's crustal plates collide?*	Set the purpose with a focus question or goal statement.	**Show slide 3.** We have a new focus question for this lesson that builds on the focus questions from previous lessons: *What evidence can we find to support the idea that mountains form when Earth's crustal plates collide?* Write this question in your science notebooks and draw a box around it. **ELL support:** You may want to rephrase the focus question so that ELL students can understand it better. **NOTE TO TEACHER:** *Write the focus question on the board for students to see and refer to throughout the lesson. Briefly review focus questions from previous lessons and highlight any connections with today's focus question.*		
5 min	**Setup for Activity** **Synopsis:** The teacher links science ideas and models from previous lessons to today's investigation of a world map of plate boundaries to find evidence of mountain building. **Main science idea(s):** • Earth's thin outer layer	Make explicit links between science ideas and activities **before** the activity.	**Show slide 4.** Looking at another way of representing Earth's crustal plates will help us gather evidence to answer our focus question. What different models or representations of Earth's crustal, or tectonic, plates have we explored so far?	A cracked eggshell. Thin pieces of wood	

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	(crust) is made up of interlocking plates, like puzzle pieces, that scientists call *tectonic plates*. Heat from Earth's core softens a thick layer of rock beneath the crust, causing it to heat up and rise very slowly toward the surface. Earth's tectonic plates float, or ride, on top of this hot underlying layer of rock, which causes the plates to move in different directions.		What did we learn about Earth's surface from these models? What evidence did we find from using these models to support our ideas about Earth's plates?	floating on oil. Foam mats. Graham crackers. The surface is thin. The crust is made up of sections that fit together like puzzle pieces. The plates move in different directions because they're floating on a layer of hot rock that's moving slowly underneath them. The models helped us see how the plates might move and what might happen when they do.	Which model showed us these features? Which model showed us that Earth's crust floats on hot, slowly moving rock? Tell us more about using models and how they might help us understand

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				I don't think the models gave us any real evidence that supports our ideas. They're just models, not the real Earth.	science ideas.
			We think that plate collisions are involved in mountain building, but we need more evidence. So we're going to look at another model of Earth's crust—a world map that scientists have developed to show how Earth's plates move.		
15 min	**Activity** **Synopsis:** Students examine a map of plate boundaries around the world and make predictions about where Earth's crustal plates might collide. **Main science idea(s):** • Earth's tectonic plates move in different directions. They can move toward each other and collide; they can move apart; or they can move side to side, sliding past each other. A world map of plate boundaries	Select content representations and models matched to the learning goal and engage students in their use.	**NOTE TO TEACHER:** *Distribute handout 4.1 (Map of Plate Boundaries around the World). This world map shows the movements of Earth's tectonic plates.* ***Display a copy of this handout on a document reader or Smart Board throughout the activity****.* **Show slide 5.** Let's look at this map of Earth. What do you notice? **NOTE TO TEACHER:** *Allow 1–2 minutes for students to share their general observations before you advance to the questions on the next slide.* **Show slide 6.**		

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	provides evidence of collisions that sometimes take place where Earth's plates move toward each other.	Engage students in analyzing and interpreting data and observations. Ask questions to elicit student ideas and predictions.	Now think about how this map relates to our eggshell model of Earth from an earlier lesson. **ELL support:** Display the cracked eggshell from lesson 2a for students to refer to throughout this discussion. Look at these lines on the map. *[Point to the plate-boundary lines.]* How do you think these lines relate to our cracked eggshell? **ELL support:** Introduce and explain important vocabulary words here. Label the map on the document reader with these terms and any other key terms that are important. Relate the lines on the map to boundaries or edges when talking about Earth's plates. Also try showing ELL students the map first without connecting it to the egg; then introduce the relationship between the two. Yes, these lines show the edges or borders of Earth's plates. These edges show the boundaries between two crustal, or tectonic, plates. How would you describe the plates on the map? Are they large or small? Do they touch? Are the borders even or uneven?	I think the lines on the map are like the cracks in the broken eggshell. The edges of Earth's plates?	So what do you think the lines represent on the map?

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			How many plates do you see on the map? Come up to projected map and trace the plate edges or boundaries. **NOTE TO TEACHER:** *This question is designed to focus students' attention on the plate-boundary lines, so an exact count of plate boundaries isn't essential here. However, make sure students don't confuse continents with plate boundaries.* **CONTENT NOTE FOR TEACHER:** *Although there are a number of smaller tectonic plates on Earth, there are seven major or primary ones: the African Plate, the Antarctic Plate, the Eurasian Plate, the Indo-Australian Plate, the North American Plate, the Pacific Plate, and the South American Plate.* Now look at the arrows on the map. What could these arrows possibly mean? What do you think they're showing, and how do you think they relate to our foam-mat model? Right! The arrows show the different	I see seven. There are eight! I only see six. I think the arrows are the direction that the plates are moving, just like the arrows we used with the foam mats.	

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			directions Earth's plates are moving. What makes the plates move? **ELL support:** Highlight what ELL students learned from a previous lesson or model. Ask, "What have we learned so far about what makes the plates move?" Displaying ideas from previous lessons on chart paper will give ELL students a reference to use (rather than relying on memory alone). Earth's crustal plates are always moving because the hot rock inside Earth is always in motion. But they're moving *very* slowly. **Show slide 7.** **Turn and Talk (2–3 min):** Now I'd like you to pair up and examine the map on your handouts more closely. Share your observations and ideas about the plates and arrows with your partner and try to make sense of what you see. Think about the questions on the slide: • What else do you notice about the plates and the arrows? • What do you think it means? • What evidence do you think the map provides that might support our ideas about Earth's plates and	A layer of hot, slow-moving rock underneath Earth's crust. The plates float on the hot rock that's moving beneath them.	
		Highlight key science ideas and focus question throughout.			*Probe and challenge questions to ask pairs:* • Which direction are the arrows moving on either side of the blue line in the Atlantic Ocean? What does that mean? • Do the plates cover the entire planet, or are they

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			mountain building? **ELL support:** Provide more explicit scaffolding for ELL students as they examine the plates and the arrows on the map. Specify two or three observations for each category. **NOTE TO TEACHER:** *If students need help focusing on what to discuss during the Turn and Talk, have them use these sentence starters:* • *I think the lines on this map show _____.* • *I think the arrows on this map show _____.* **Whole-class share-out:** OK, let's hear some of your observations. **Show slide 8.** **Turn and Talk:** Now I want you and your partner to look at the map again. This time, make predictions about where you think plates might collide. Draw a circle around those locations on your maps. Then write your ideas in your science notebooks using the sentence starters on the slide. Be ready to share your ideas and reasoning with the class.	*[Students will likely focus on the direction of different plates movements.]*	only in certain places? • Are the plate boundaries the same as the boundaries of continents or oceans?
		Ask questions to elicit student ideas and predictions.			

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			ELL support: Have ELL students talk together about why they think the plates collide.		
5 min	**Follow-Up to Activity** **Synopsis:** Students discuss their predictions about where Earth's tectonic plates might collide and what might happen at these plate boundaries. **Main science idea(s):** • A world map of plate boundaries supports the idea that Earth's tectonic plates move in three basic ways: They move toward each other and collide; they move apart; and they move side to side, sliding past each other. A plate-boundary map also shows where Earth's plates might collide and form mountain ranges.	Make explicit links between science ideas and activities **after** the activity.	**Show slide 9.** Let's have a few volunteers come up to the document reader *[or Smart Board]* one at a time and point to one place on the map where you predicted two of Earth's crustal plates might collide. What landforms might you see at the places where Earth's plates collide? Why do you think that? Now try to imagine two gigantic sections of Earth's crust colliding. Remember that Earth's crust is made up of a thin layer of cold, hard rock. Do you think it's really possible for this hard crustal rock to bend and break and get pushed up into a mountain range like we observed with the crumpled-up graham crackers?	The crust is really thin, so it might bend and break. Maybe it could break if there was a very strong force. Or if the crust got soft at	*For each area students point to on the map, ask these questions:* • Why did you pick that spot? • What kind of landform would you expect to see in this location?

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			So we have some ideas about where Earth's plates collide, and some of you predict that we'd see mountains in those places.	the edges, like the graham crackers.	
5 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** Students use new information about Earth's crustal plates to synthesize their ideas about how mountains form. **Main science idea(s):** • When Earth's tectonic plates move toward each other and collide, they form mountain ranges**.**	Engage students in making connections by synthesizing and summarizing key science ideas. Highlight key science ideas and focus question throughout.	**Show slide 10.** Today we investigated a map of plate boundaries around the world to see if we could find evidence to support our idea that plate collisions form mountains. In our last lesson, you completed this sentence describing how you think mountains form: *I think mountains are formed by _____ .* *Embedded Assessment Task* Read the sentence you wrote in your notebooks and then *add to* or *change* your answers to reflect your current ideas based on what you learned from today's map investigation. As you revise your answers, think about today's focus question: *What evidence can we find to support the idea that mountains form when Earth's crustal*		

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			plates collide?		
1 min	**Link to Next Lesson** **Synopsis:** The teacher informs students that next time, they'll collect additional data from new maps to support the idea that mountains form where Earth's tectonic plates collide.	Link science ideas to other science ideas.	**Show slide 11.** So from our map investigation today, we found evidence that Earth's crustal plates collide at plate boundaries. But are these plate collisions involved in mountain building? In our next lesson, we'll see if we can gather more evidence to support this idea.		