Earth's Changing Surface
Lesson 3a: In What Ways Do Earth's Plates Move?

Grade 4	**Length of lesson:** 40 minutes	**Placement of lesson in unit:** 3a 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:** Are the moving plates of Earth's crust involved in building up Earth's surface and forming mountains? If so, how?
Main learning goal: Earth's tectonic plates move in different directions. They can move toward each other (collide), move away from each other, or move side to side.		
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*. These plates float on a thick layer of hot, slow-moving rock under the surface. Heat from Earth's core softens this rock, causing it to rise. As this underlying layer rises toward the surface, it causes the rigid plates of Earth's crust to move in different direction—toward each other (colliding), away from each other, or side to side.		
Ideal student response to the focus questions: Earth's crust is made up of plates that fit together like puzzle pieces. All of these plates move, but not in the same direction. Some plates move toward each other; some plates move apart; and some plates move side to side, sliding past each other.		

Preparation

Materials Needed • Student notebooks • Chart paper and markers • Foam mats (4" × 6" sections recommended) (2 per pair of students) • Construction-paper arrows (2 per pair of students) **Student Handouts and Teacher Masters** • 3.1 Arrows (Teacher Master) (see Ahead of Time)	**Ahead of Time** • Review Earth's Changing Surface Content Background Document: sections 4–6. • Cut out enough construction-paper arrows (handout 3.1) so each pair of students has 2 arrows.

Lesson 3a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
3 min	**Link to previous lesson:** Review the science ideas about volcanic activity and plate movement related to mountain building.	• Volcanic eruptions can build up mountains over time. • Earth's thin outer crust consists of interlocking tectonic plates that float on a thick layer of hot, slowly moving rock inside Earth. The movement of these plates might or might not be related to mountain building.
1 min	**Lesson focus questions:** The teacher introduces the focus questions, *Are the moving plates of Earth's crust involved in building up Earth's surface and forming mountains? If so, how?*	
5 min	**Setup for activity:** The teacher introduces foam mats as a model of Earth's tectonic plates.	• Earth's thin outer layer, or crust, consists of tectonic plates that float on a thick layer of hot, slowly moving rock. This layer of rock inside Earth makes the rigid plates of Earth's crust move in different directions.
15 min	**Activity:** Using directional arrows and foam mats representing Earth's crustal plates, pairs of students model possible plate movements and interactions. Then students record and draw pictures of all their ideas in their science notebooks.	• Foam mats can be used to model Earth's tectonic plates and explore all the ways these plates might move in relationship to one another.
10 min	**Follow-up to activity:** Students share their representations (drawings) of plate movements and critique one another's ideas.	• Earth's tectonic plates can move toward each other and collide; they can move away from each other; and they can move side to side.
5 min	**Synthesize/summarize today's lesson:** Students summarize their current ideas about how Earth's crustal (tectonic) plates move. Then they propose ideas about which plate movements might cause mountains to form.	• When Earth's tectonic plates move toward each other, they can collide. These plate collisions might be involved in building mountains on Earth's surface.
1 min	**Link to next lesson:** The teacher previews the next lesson in which students compare their ideas about plate movement to the ideas of scientists and explore another model of Earth's plates.	

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3 min	**Link to Previous Lesson** **Synopsis:** Review the science ideas about volcanic activity and plate movement related to mountain building. **Main science idea(s):** • Volcanic eruptions can build up mountains over time. • Earth's thin outer crust consists of interlocking tectonic plates that float on a thick layer of hot, slowly moving rock inside Earth. The movement of these plates might or might not be related to mountain building.	Highlight key science ideas and focus question throughout. Link science ideas to other science ideas.	**Show slides 1 and 2.** Last time, our focus question was *What happens to Earth's surface that causes mountains to form?* What have we discovered so far about Earth's surface? What do you think causes mountains to form? **ELL support:** Ask ELL students *how* mountains are built up rather than asking what causes them to form. So volcanic activity is one way Earth's surface gets built up. What did we learn about Earth's crustal plates?	Erupting volcanoes build up mountains. They're called *tectonic plates*. They're like puzzle pieces that fit together. The plates are thin. The plates move. Plates move because they're floating on top of soft, hot rock underneath the surface that's moving	Tell us more about that. Who can add on to that? Can you say more about this plate movement?

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			Today we'll explore more about plate movement and how that might relate to building mountains on Earth's surface.	very slowly.	Do you think this has anything to do with forming mountains?
1 min	**Lesson Focus Questions** **Synopsis**: The teacher introduces the focus questions, *Are the moving plates of Earth's crust involved in building up Earth's surface and forming mountains? If so, how?*	Set the purpose with a focus question or goal statement.	**Show slide 3.** That brings us to our focus questions for today: *Are the moving plates of Earth's crust involved in building up Earth's surface and forming mountains? If so, how?* Write these questions in your science notebooks and draw a box around them. **NOTE TO TEACHER:** *Write the focus questions on the board for students to see and refer to throughout the lesson.*		
5 min	**Setup for Activity** **Synopsis:** The teacher introduces foam mats as a model of Earth's tectonic plates. **Main science idea(s):** • Earth's thin outer layer, or crust, consists of tectonic plates that float on a thick layer of hot,	Make explicit links between science ideas and activities **before** the activity.	Let's dig a little deeper and investigate what's happening when Earth's tectonic plates move. We want to figure out *all* the possible ways these plates might move at the boundaries between different plates. To do this, we're going to use a new model of Earth's crust. What have we used to model Earth's crust in other lessons?	A hard-boiled egg.	

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	slowly moving rock. This layer rock inside Earth makes the rigid plates of Earth's crust move in different directions.		Right! First, we used a hard-boiled egg to model the different inner and outer layers of Earth. Then we used a cracked eggshell to represent how Earth's thin crustal plates fit together like puzzle pieces. We also used pieces of balsa wood to model how tectonic plates float on a layer of hot, slow-moving rock underneath Earth's surface. **Show slide 4.**	An eggshell. Thin pieces of wood floating on oil.	
		Select content representations and models matched to the learning goal and engage students in their use.	Today we're going to use foam mats that represent Earth's crustal plates and arrows that show the possible directions these plates might move. I want you to imagine that each foam mat is one of the different interlocking plates that make up Earth's crust. Think of all these plates as pieces of a cracked eggshell. **ELL support:** When referring to Earth's crustal (tectonic) plates, make sure to keep language as consistent as possible. Use this term when appropriate and connect it to terms you've already introduced.		

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			As we learned in previous lessons, the whole Earth is made up of crustal plates that are always touching. But these plates also move. So what do you think might happen when plates that are touching each other move around? You've come up with some good ideas! Now let's see what a new model can tell us about how Earth's plates move.	They might bend upward. They might crash into each other. They might move up and down or slide past each other.	
15 min	**Activity** **Synopsis:** Using directional arrows and foam mats representing Earth's crustal plates, pairs of students model possible plate movements and interactions. Then students record and draw pictures of all their ideas in their science notebooks. **Main science idea(s):** • Foam mats can be used to model Earth's tectonic plates and	Select content representations and models matched to the learning goal and engage students in their use.	**NOTE TO TEACHER:** *Have students pair up; then distribute two foam mats and two direction arrows (cutouts from handout 3.1) to each pair.* **Show slide 5.** You and your partner will use these foam mats and the direction arrows to model how Earth's plates move. First, lay your two mats next to each other on the table with the sides touching. Make sure to keep your mats on the table throughout the activity. Imagine that the table is the hot, slow-		

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	explore all the ways these plates might move in relationship to one another.		moving rock underneath Earth's crust that the plates are floating on. Try to think of all the possible directions the plates could move as they float on this layer of rock. Push your mats in each of these different directions. **Show slide 6.** During our investigation, think about the questions on the slide: • As the plates float on top of the hot layer of rock underneath them, what different movements might take place at the boundary where two plates meet? • What might happen to the plates during each of these different movements? Model as many different plate movements and interactions as you can think of. Then record your ideas and drawings in your science notebooks. Make sure to label your drawings! **NOTE TO TEACHER:** *Students might get very creative with their mats, but they'll likely point the arrows in the same direction, toward each other, away from each other, or up and down to show plates sliding past each other.*		

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		Ask questions to probe student ideas and predictions. Ask questions to challenge student thinking.	*See whether any students think of sliding one piece of foam under or over the other. This is a type of collision.* *As pairs work on this brainstorming task, circulate around the room, asking probe and challenge questions. (See sample challenge questions in the right-hand column.)* *While you're monitoring their work,* ***ask four or five students to share their ideas with the class following the activity****. While the rest of the class is finishing up, have these students draw their ideas on the board. Choose one student to draw colliding plates, one to show plates moving apart, and one to show plates moving side to side. If a student has a different idea, you might ask him or her to draw that idea on the board as well.*		*Challenge questions that link student models to Earth in real life:* • If the plates moved like that on Earth, what do you think it would do to the shape of Earth's surface? • Can you think of other things that might happen? • What landform do you think you might see on Earth if that happened?
10 min	**Follow-Up to Activity** **Synopsis:** Students share their representations (drawings) of plate movements and critique one another's ideas.	Make explicit links between science ideas and activities **after** the activity. Engage students in	I asked a few of you to draw on the board your ideas about possible ways Earth's plates move. Let's hear your ideas, starting with what happens when Earth's plates collide. While your classmates share their ideas,		

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	Main science idea(s): • Earth's tectonic plates can move toward each other and collide; they can move away from each other; and they can move side to side.	analyzing and interpreting data and observations. Engage students in communicating in scientific ways.	listen carefully and think about whether you agree or disagree. Be prepared to offer comments, ask questions, and make suggestions after the presentations. **NOTE TO TEACHER:** *Have presenters explain their ideas and drawings one at a time and then give the rest of the class an opportunity to ask questions and give feedback.* **Show slide 7.** **Whole-class discussion:** So how many different ideas do we see on the board that show how Earth's plates might move? What happens to the plates in each drawing? Does anyone have a different idea to share about how Earth's plates might move? Come to the board and draw a picture to illustrate it. **NOTE TO TEACHER:** *Keep this discussion brief. Don't comment on whether students' ideas are right or wrong at this time. Instead, focus on listening and jotting down any interesting ideas or misunderstandings to discuss at another time.* *Often, it's difficult for students to*	I think mountains build up when the plates move together. When the plates move side to side, they can crunch up like a mountain. Maybe a volcano could	What do you mean by "move together"? Can you show us?

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		Ask questions to elicit student ideas and predictions. Ask questions to probe student ideas and predictions. Summarize key science ideas.	*translate what they see in models to events that happen in the real world. Whenever possible, keep students focused on the link between the foam model and the actual movements of Earth's crustal plates. Discuss how these movements might be involved in mountain building. To reinforce this focus, ask elicit and probe questions (e.g., "How might these movements cause mountains to form?").* **Show slide 8.** In today's investigation, we used foam mats to model some different ways that Earth's plates might move. • Plates can move toward each other and collide. • Plates can move apart or away from each other. • Plates can move side to side, sliding past each other. But do you think any of these plate movements might cause mountains to form? Why or why not? You've done a great job of brainstorming different ways Earth's crustal plates might move! Next time, we'll see if we can come up with even more ideas.	erupt in the space when the plates move apart.	Tell us more about volcanoes and Earth's plates.
5 min	**Synthesize/Summarize Today's Lesson**		**Show slide 9.**		

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	Synopsis: Students summarize their current ideas about how Earth's crustal (tectonic) plates move. Then they propose ideas about which plate movements might cause mountains to form. **Main science idea(s):** • When Earth's tectonic plates move toward each other, they can collide. These plate collisions might be involved in building mountains on Earth's surface.	Highlight key science ideas and focus question throughout. Engage students in making connections by synthesizing and summarizing key science ideas.	Before we end today's lesson, let's revisit our focus questions: *Are the moving plates of Earth's crust involved in building up Earth's surface and forming mountains? If so, how?* How would you answer these questions now based on today's investigation? Think for a moment about the different plate movements and interactions we modeled with the foam mats. And don't forget to look at the drawings on the board. Then write an answer to the focus questions in your science notebooks. Make sure to include evidence from our investigation. If your answer to the first question is yes, don't forget to answer the second question: *If so, how?*		
1 min	**Link to Next Lesson** **Synopsis:** The teacher previews the next lesson in which students compare their ideas about plate movement to the ideas of scientists and explore another model of Earth's plates.	Link science ideas to other science ideas.	**Show slide 10.** Next time, we'll compare our ideas about how Earth's tectonic plates might move with what scientists know about their actual movements. We'll also examine another model of Earth's plates.		