FLORIDA

LESSON 3

The Theory of Plate Tectonics

UNLOCK THE ESSENTIAL QUESTION

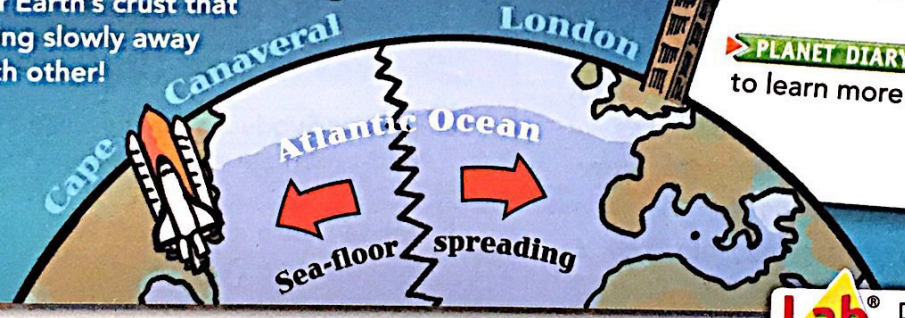
What Is the Theory of Plate Tectonics?

SC.7.E.6.5, LA.7.2.2.3

MY PLANET DIARY for Florida

Slip-Sliding Away

In 30 million years, this airplane might take one hour longer to fly from Florida to London than it takes today. That's because Florida and Europe are riding on two different pieces of Earth's crust that are moving slowly away from each other!



FUN FACT

Answer the question below.

Why will Florida be farther from London in 30 million years?

PLANET DIARY Go to Planet Diary to learn more about Earth's crust.

Lab zone® Do the Inquiry Warm-Up *Plate Interactions.*

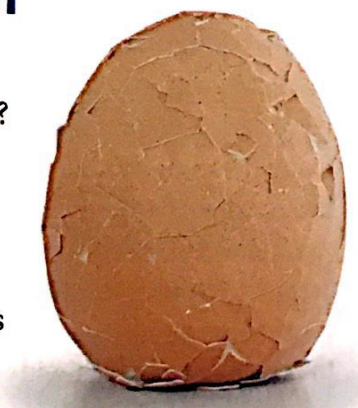
FLORIDA NGSSS

SC.7.E.6.5 Explore the scientific theory of plate tectonics by describing how the movement of Earth's crustal plates causes both slow and rapid changes in Earth's surface, including volcanic eruptions, earthquakes, and mountain building.

LA.7.2.2.3 The student will organize information to show understanding (e.g., representing main ideas within text through summarizing).

What Is the Theory of Plate Tectonics?

Have you ever dropped a hard-boiled egg? The eggshell cracks into uneven pieces. Earth's lithosphere, its solid outer shell, is like that eggshell. It is broken into pieces separated by cracks. These pieces are called **plates.** Earth's major tectonic plates are shown in **Figure 1.**



Vocabulary

- plate
- divergent boundary
- convergent boundary
- transform boundary
- plate tectonics
- fault
- rift valley

Skills

- Reading: Relate Cause and Effect
- Inquiry: Calculate

Earth's plates meet at boundaries. Along each boundary, plates move in one of three ways. Plates move apart, or diverge, from each other at a **divergent boundary** (dy VUR junt). Plates come together, or converge, at a **convergent boundary** (kun VUR junt). Plates slip past each other along a **transform boundary.**

In the mid-1960s, geologists combined what they knew about sea-floor spreading, Earth's plates, and plate motions into a single theory called **plate tectonics.** **The theory of plate tectonics states that Earth's plates are in slow, constant motion, driven by convection currents in the mantle.** Plate tectonics explains the formation, movement, and subduction of Earth's plates.

Mantle Convection and Plate Motions

What force is great enough to move the continents? Earth's plates move because they are the top part of the large convection currents in Earth's mantle. During subduction, gravity pulls denser plate edges downward, into the mantle. The rest of the plate also moves. The motion of the plates is like the motion of liquid in a pot of soup heating on a stove.

FIGURE 1

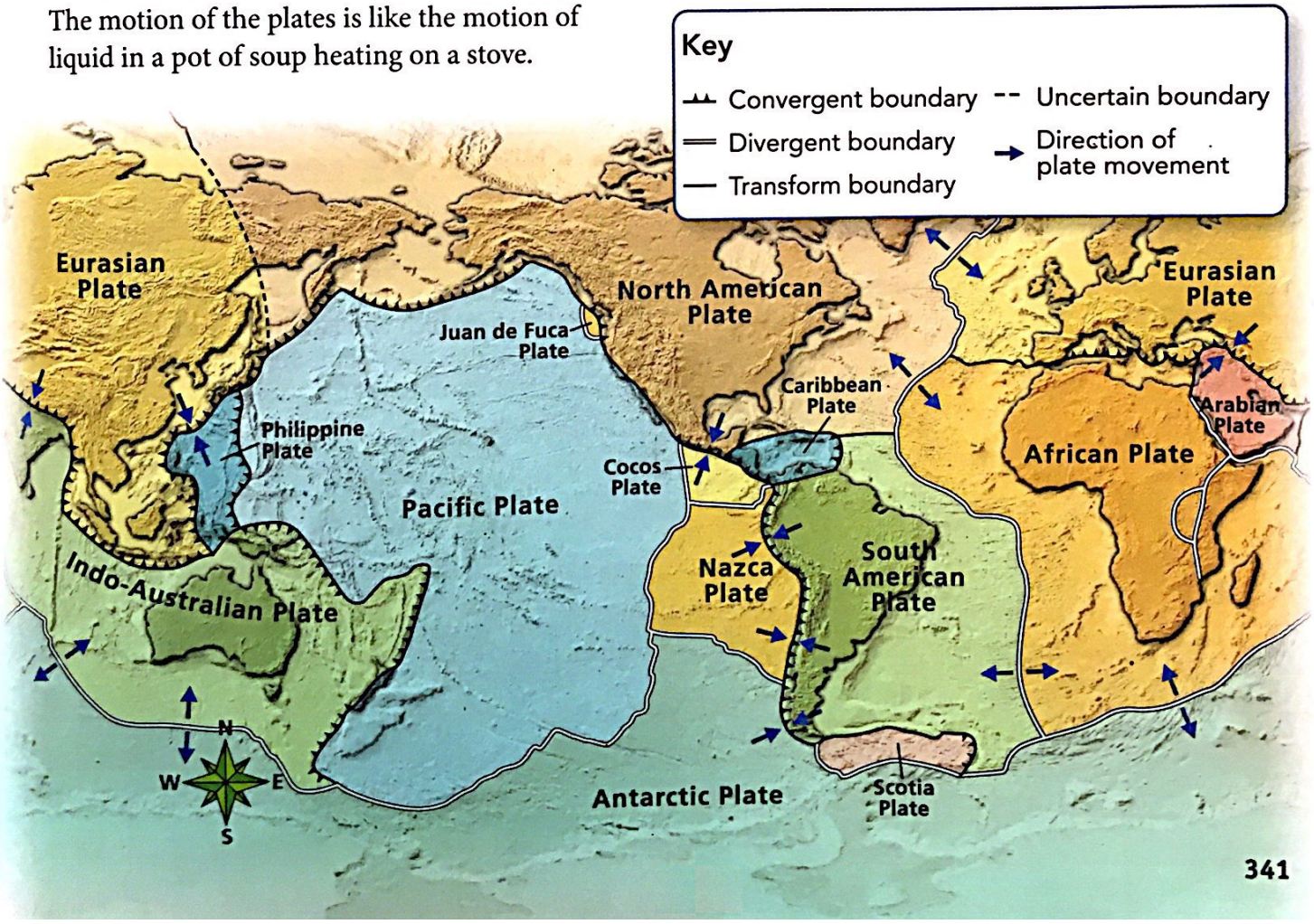
REAL-WORLD INQUIRY

Earth's Plates

Plate boundaries divide the lithosphere into large plates.

Interpret Maps

1. Study the map key. Then draw arrows at all boundaries of the Pacific plate to show the directions that the plates move.
2. Circle the name of the plate that Florida is on.



Relate Cause and Effect
What has caused the location of Earth's continents to change over time?

Plate Motions Over Time

Scientists use satellites to measure plate motion precisely. The plates move very slowly—from about 1 to 12 centimeters per year. The North American and Eurasian plates move apart at a rate of 2.5 centimeters per year. That's about as fast as your fingernails grow. Because the plates have been moving for tens to hundreds of millions of years, they have moved great distances.

Over time, the movement of Earth's plates has greatly changed the location of the continents and the size and shape of the oceans. As plates move, they change Earth's surface, producing earthquakes, volcanoes, mountain ranges, and deep-ocean trenches. Geologists have evidence that, before Pangaea existed, other supercontinents formed and split apart over the last billion years. Pangaea itself formed when Earth's landmasses moved together about 350 to 250 million years ago. Then, about 200 million years ago, Pangaea began to break apart, as shown in **Figure 2.**

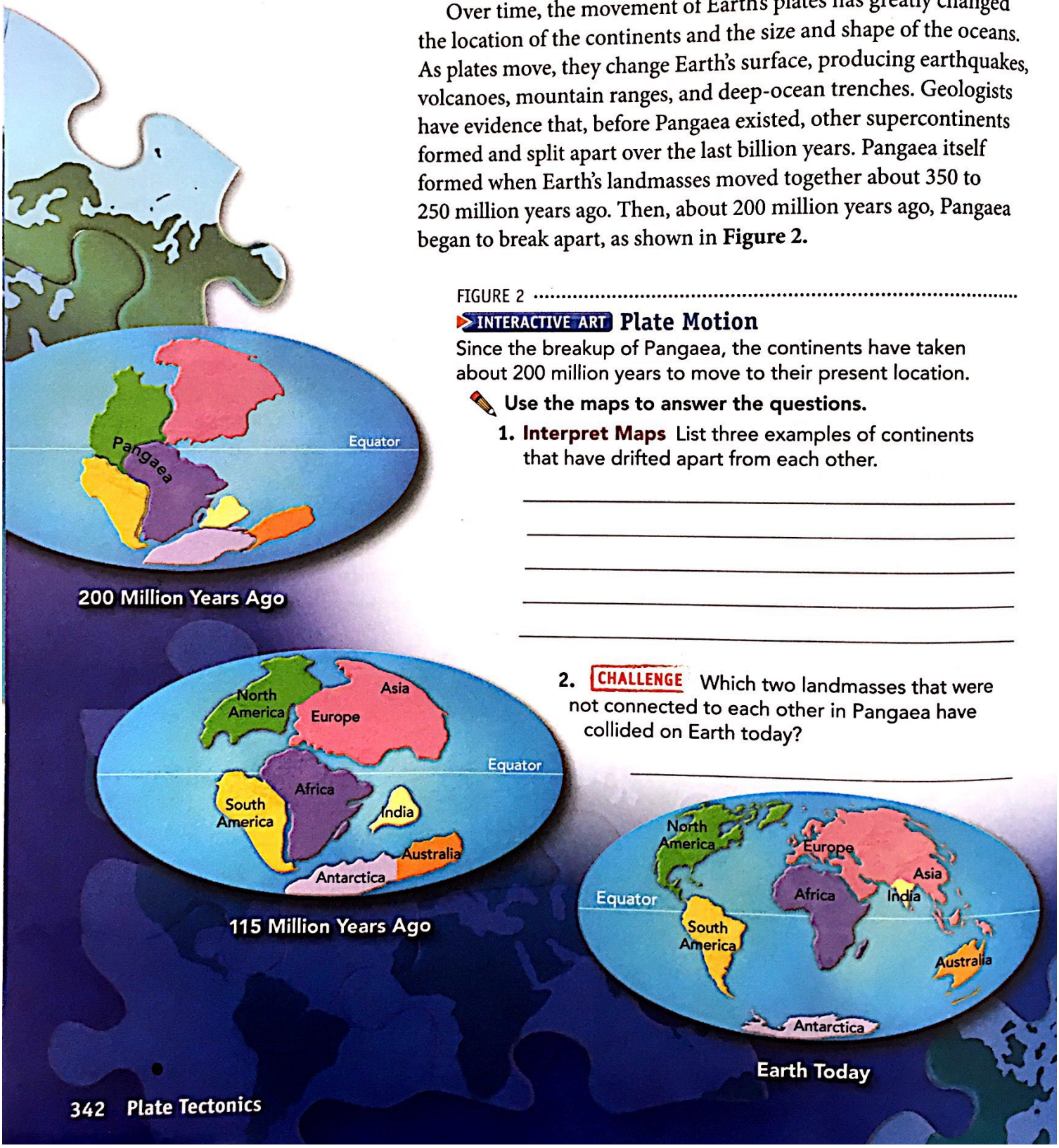
FIGURE 2

INTERACTIVE ART **Plate Motion**

Since the breakup of Pangaea, the continents have taken about 200 million years to move to their present location.

Use the maps to answer the questions.

1. **Interpret Maps** List three examples of continents that have drifted apart from each other.



2. CHALLENGE Which two landmasses that were not connected to each other in Pangaea have collided on Earth today?

Plate Boundaries

Recall that the edges of Earth's plates meet at plate boundaries. **Faults**—breaks in Earth's crust where rocks have slipped past each other—form along these boundaries. Convection currents in Earth's mantle cause the plates to move. As the plates move, they collide, pull apart, or grind past each other. These movements produce great changes in Earth's surface and on the ocean floor. These changes include the formation of volcanoes, mountain ranges, and deep-ocean trenches.

Divergent Boundaries

Can a crack in Earth's crust be so wide that people can walk through it? In Iceland it can! There, two plates move slowly away from each other. **Figure 3** shows part of the crack that has formed as these two plates have moved apart over time.

Recall that plates move away from each other at a divergent boundary. Most divergent boundaries occur along the mid-ocean ridges, where new crust is added during sea-floor spreading. But in a few places, the mid-ocean ridge rises above sea level. Volcanic activity of the mid-Atlantic ridge is also seen in Iceland.

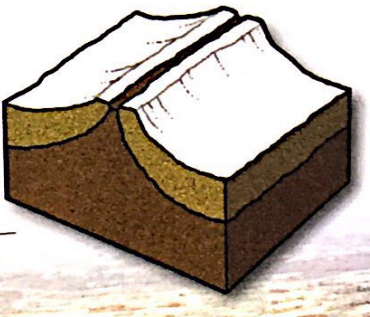
Where pieces of Earth's crust diverge on land, a deep valley called a **rift valley** forms. Several rift valleys make up the East African rift system. There, the crust is slowly pulling apart over a wide area.

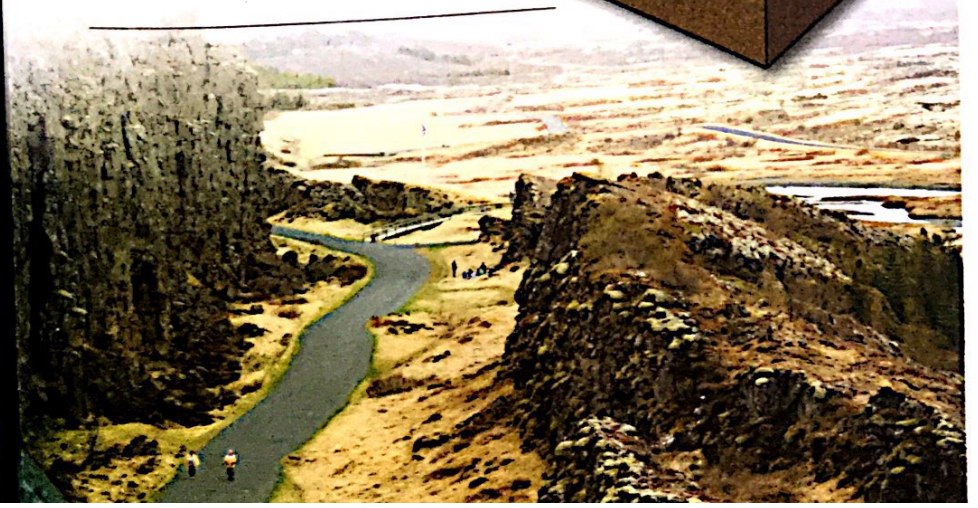
FIGURE 3

Breaking Up Is Hard to Do

Two plates separate to form a great crack in Iceland, marking a divergent boundary.

Explore Scientific Theories **Draw arrows on the diagram to show how plates can move at a divergent boundary. Then describe how this plate movement can change Earth's surface.**





Vocabulary Prefixes Read the text about the three types of plate boundaries. Circle the correct meaning of each prefix given here.

Di- = (away/together/along)

Con- = (away/together/along)

Trans- = (away/together/along)

do the math!

Plates move at very slow rates. These rates are from about 1 to 12 cm per year. To calculate rates of motion, geologists use the following formula.

$$\text{Rate} = \frac{\text{Distance}}{\text{Time}}$$

Calculate The Pacific plate is sliding past the North American plate. In 10 million years, the plate will move 500 km. What is the Pacific plate's rate of motion? Express your answer in centimeters per year.

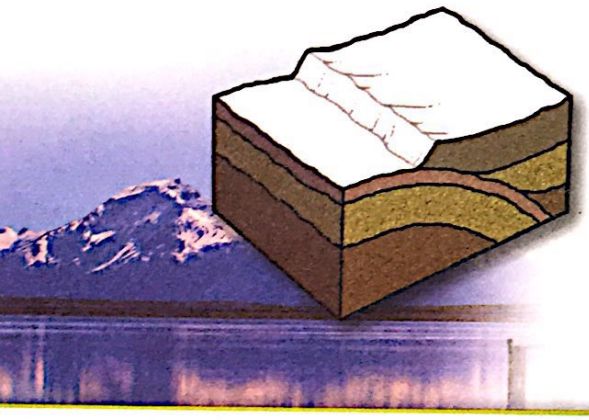
MA.7.A.1.6

FIGURE 4

The Andes

The Andes Mountains formed at a convergent boundary.

Explore Scientific Theories **Draw arrows on the diagram to show how plates move when they converge. Describe how this plate movement can change Earth's surface.**



Convergent Boundaries The Andes Mountains run for 8,900 kilometers along the west coast of South America. Here, two plates collide. Recall that a boundary where two plates come together, or collide, is called a convergent boundary.

What happens when two plates collide? The density of the plates determines which one comes out on top. Oceanic crust becomes cooler and denser as it spreads away from the mid-ocean ridge. Where two plates carrying oceanic crust meet at a trench, the plate that is more dense sinks under the less dense plate.

A plate carrying oceanic crust can also collide with a plate carrying continental crust. Oceanic crust is more dense than continental crust. The more dense oceanic crust can push up the less dense continental crust. This process has slowly formed the Andes, as shown in **Figure 4.** Meanwhile, the more dense oceanic crust also sinks as subduction occurs. Water eventually leaves the sinking crust and rises into the wedge of the mantle above it. This water lowers the melting point of the mantle in the wedge. As a result, the mantle partially melts and rises up as magma. The magma can erupt suddenly to form volcanoes on Earth's surface.

Two plates carrying continental crust can also collide. Then, neither piece of crust is dense enough to sink far into the mantle. Instead, the collision squeezes the crust into high mountain ranges.

EXPLORE THE ESSENTIAL

Earth's Changing Crust

How do moving plates change Earth's crust?

FIGURE 6

ART IN MOTION As plates move, they produce mountains, volcanoes, and valleys as well as mid-ocean ridges and deep-ocean trenches.

Identify **Fill in the blanks with the correct terms from the list on the next page. (*Hint:* Some points use more than one term.)**

Transform Boundaries Recall that a transform boundary is a place where two plates slip past each other, moving in opposite directions. Beneath the surface of a transform boundary, the sides of the plates are rocky and jagged. So, the two plates can grab hold of each other and "lock" in place. Forces inside the crust can later cause the two plates to unlock. Earthquakes often occur when the plates suddenly slip along the boundary that they form. These earthquakes can cause rapid changes in Earth's surface. However, crust is neither created nor destroyed at transform boundaries. The San Andreas fault, shown in **Figure 5,** is one example of a transform boundary.

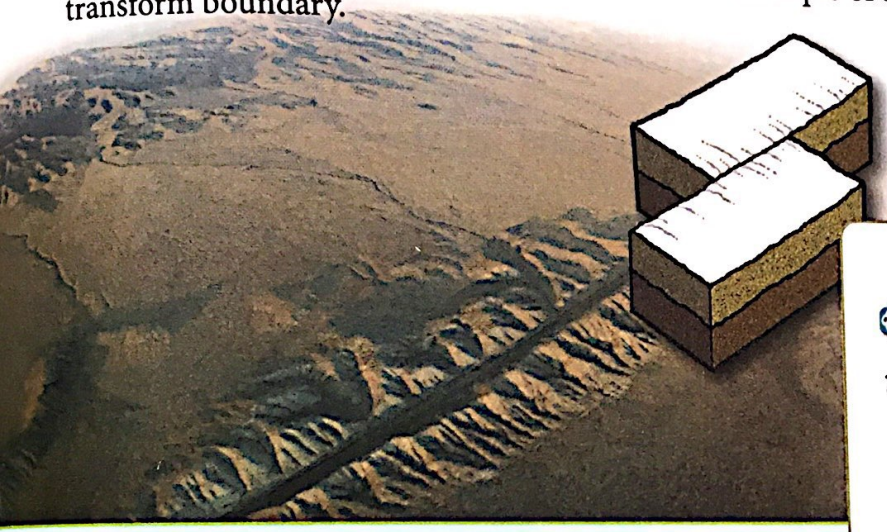


FIGURE 5

Fault Line
The San Andreas fault in California marks a transform boundary.

Explore Scientific Theories
Draw arrows on the diagram to show how plates move at a transform boundary. Describe how this plate movement can change Earth's surface.

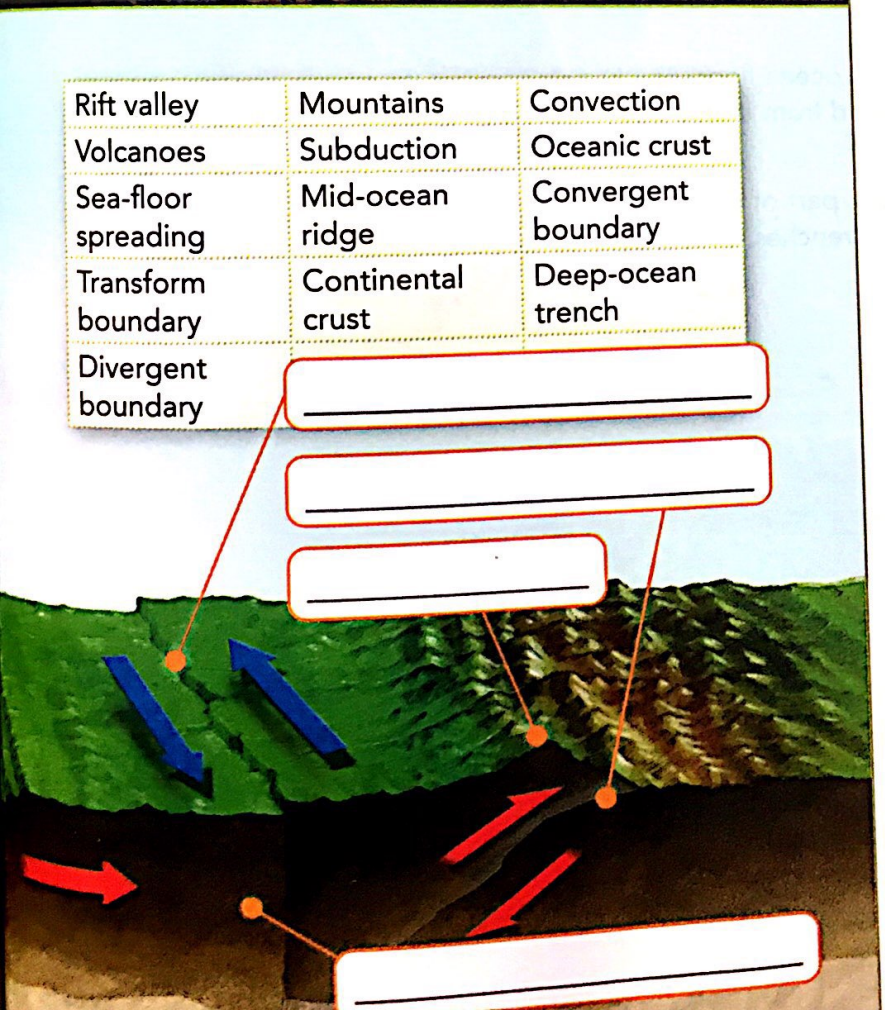
_____

_____

_____

Lab zone Do the Quick Lab *Mantle Convection Currents.*

Rift valley	Mountains	Convection
Volcanoes	Subduction	Oceanic crust
Sea-floor spreading	Mid-ocean ridge	Convergent boundary
Transform boundary	Continental crust	Deep-ocean trench
Divergent boundary		



Assess Your Understanding

1a. Review Plates move apart at (divergent/convergent/transform) boundaries.
SC.7.E.6.5

b. ANSWER THE ESSENTIAL ? **Summarize** How do moving plates change Earth's crust?

_____

_____

_____

_____

_____

_____

_____

_____

SC.7.E.6.5, LA.7.2.2.3

got it?

○ **I get it!** Now I know that the theory of plate tectonics states that _____

_____

_____

_____

○ I need extra help with _____

Go to **my science coach** *online for help with this subject.* SC.7.E.6.5