

# The Theory of Plate Tectonics

## BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is the theory of plate tectonics?
- What are the three types of tectonic plate boundaries?

**National Science  
Education Standards**  
ES 1b, 2a

## What Is the Theory of Plate Tectonics?

As scientists learned more about sea-floor spreading and magnetic reversals, they formed a theory to explain how continents move. The theory of **plate tectonics** states that Earth's lithosphere is broken into many pieces—tectonic plates—that move slowly over the asthenosphere.

Tectonic plates move very slowly—only a few centimeters per year. Scientists can detect this motion only by using special equipment, such as global positioning systems (GPS). This equipment is sensitive enough to pick up even small changes in a continent's location. ✓



**Compare** As you read, make a table showing the features of the three kinds of plate boundaries.

## What Happens Where Tectonic Plates Touch?

The places where tectonic plates meet are called *boundaries*. Some features, such as earthquakes and volcanoes, are more common at tectonic plate boundaries than at other places on Earth. Other features, such as mid-ocean ridges and ocean trenches, form only at plate boundaries.

There are three types of plate boundaries:

- divergent boundaries, where plates move apart;
- convergent boundaries, where plates move together; and
- transform boundaries, where plates slide past each other.

The features that form at a plate boundary depend on what kind of plate boundary it is.

### DIVERGENT BOUNDARIES

A **divergent boundary** forms where plates are moving apart. Most divergent boundaries are found beneath the oceans. Mid-ocean ridges form at these divergent boundaries. Because the plates are pulling away from each other, cracks form in the lithosphere. Melted rock can rise through these cracks. When the melted rock cools and hardens, it becomes new lithosphere. ✓



**1. Explain** How do scientists detect tectonic plate motions?

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**2. Describe** What features are found at most divergent boundaries?

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**SECTION 3** The Theory of Plate Tectonics *continued*

**Critical Thinking**

3. Infer Why do continent-continent convergent boundaries produce very tall mountain ranges?

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**STANDARDS CHECK**

**ES 1b** Lithospheric plates on the scales of continents and oceans constantly move in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building result from these plate motions.

**Word Help: response**  
an action brought on by another action; a reaction

**Word Help: major**  
of great importance or large scale

4. Identify Name two structures that can form at convergent plate boundaries.

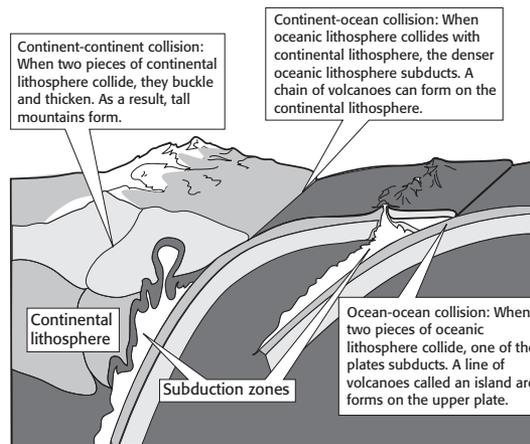
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**CONVERGENT BOUNDARIES**

A **convergent boundary** forms where plates are moving together. There are three different types of convergent boundaries:

- **Continent-Continent Boundaries** These form when continental lithosphere on one plate collides with continental lithosphere on another plate. Continent-continent convergent boundaries can produce very tall mountain ranges, such as the Himalayas.
- **Continent-Ocean Boundaries** These form when continental lithosphere on one plate collides with oceanic lithosphere on another plate. The denser oceanic lithosphere sinks underneath the continental lithosphere in a process called *subduction*. Subduction can cause a chain of mountains, such as the Andes, to form along the plate boundary.
- **Ocean-Ocean Boundaries** These form when oceanic lithosphere on one plate collides with oceanic lithosphere on another plate. One of the plates subducts beneath the other. A series of volcanic islands, called an *island arc*, can form along the plate boundary.



**TRANSFORM BOUNDARIES**

A **transform boundary** forms where plates slide past each other horizontally. Most transform boundaries are found near mid-ocean ridges. The ridges are broken into *segments*, or pieces. Transform boundaries separate the segments from one another.

One well-known transform boundary is the San Andreas fault system in California. It is located where the Pacific and North American plates slide past each other.

**SECTION 3** The Theory of Plate Tectonics *continued***Why Do Tectonic Plates Move?**

Scientists do not know for sure what causes tectonic plates to move. They have three main hypotheses to explain plate movements: convection, slab pull, and ridge push.

Scientists used to think that convection in the mantle was the main force that caused plate motions. Remember that *convection* happens when matter carries heat from one place to another. Convection happens in the mantle as rock heats up and expands. As it expands, it becomes less dense and rises toward Earth's surface. ✓

As the hot material rises, cold, dense lithosphere sinks into the mantle at subduction zones. The rising hot material and the sinking cold material form *convection currents*. Until the 1990s, many scientists thought that these convection currents pulled the tectonic plates over Earth's surface.

Today, most scientists think that slab pull is the main force that causes plate motions. During subduction, oceanic lithosphere at the edge of a plate sinks into the mantle. The oceanic lithosphere sinks because it is colder and denser than the mantle. As the lithosphere at the edge of the plate sinks, it pulls the rest of the plate along with it. This process is called *slab pull*.

Another possible cause of plate motions is ridge push. At mid-ocean ridges, new oceanic lithosphere forms. This new lithosphere is warmer and less dense than the older lithosphere farther from the ridge. Therefore, it floats higher on the asthenosphere than the older lithosphere. As gravity pulls the new lithosphere down, the plate slides away from the mid-ocean ridge. This process is called *ridge push*.

Driving Force	Description
Slab pull	Cold, sinking lithosphere at the edges of a tectonic plate pulls the rest of the plate across Earth's surface.
Ridge push	Gravity pulls newly formed lithosphere downward and away from the mid-ocean ridge. The rest of the plate moves because of this force.
Convection currents	Convection currents are produced when hot material in the mantle rises toward the surface and colder material sinks. The currents pull the plates over Earth's surface.

 **READING CHECK**

**5. Define** What is convection?

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**Critical Thinking**

**6. Compare** How is slab pull different from ridge push?

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# Section 3 Review

NSES ES 1b, 2a

## SECTION VOCABULARY

**convergent boundary** the boundary between tectonic plates that are colliding

**divergent boundary** the boundary between two tectonic plates that are moving away from each other

**plate tectonics** the theory that explains how large pieces of the Earth's outermost layer, called tectonic plates, move and change shape

**transform boundary** the boundary between tectonic plates that are sliding past each other horizontally

**1. Define** Write your own definition for plate tectonics.

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**2. Identify** What are the three types of plate boundaries?

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**3. List** Name three processes that may cause tectonic plates to move.

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**4. Describe** How fast do tectonic plates move?

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**5. Identify** Give two features that are found only at plate boundaries, and two features that are found most commonly at plate boundaries.

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**6. Explain** Why does oceanic lithosphere sink beneath continental lithosphere at convergent boundaries?

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