Plate Tectonics

Chapter 4

The Big Idea

Plate tectonics explains the formation of many of Earth's features and geologic events.

- Lesson 1: Continental Drift
  - Despite the evidence that supported continental drift, it was rejected by most scientists.
- Lesson 2: Seafloor Spreading
  - New discoveries led to seafloor spreading as an explanation for continental drift.
- Lesson 3: Theory of Plate Tectonics
  - Earth's lithosphere is broken into large brittle pieces, which move as a result of forces acting on them.

Lesson 1: Continental Drift

Despite the evidence that supported continental drift, it was rejected by most scientists.

What you'll learn:

- **Explain Alfred Wegener's controversial hypothesis.**
- **Summarize the evidence used to support continental drift.**
- **Justify why most scientists rejected the continental drift hypothesis.**

So What?!

The continental drift hypothesis led to the development of plate tectonics – a theory that explains many of Earth's features and events.

Review Vocabulary

rock **natural, solid mixture of mineral crystal particles**

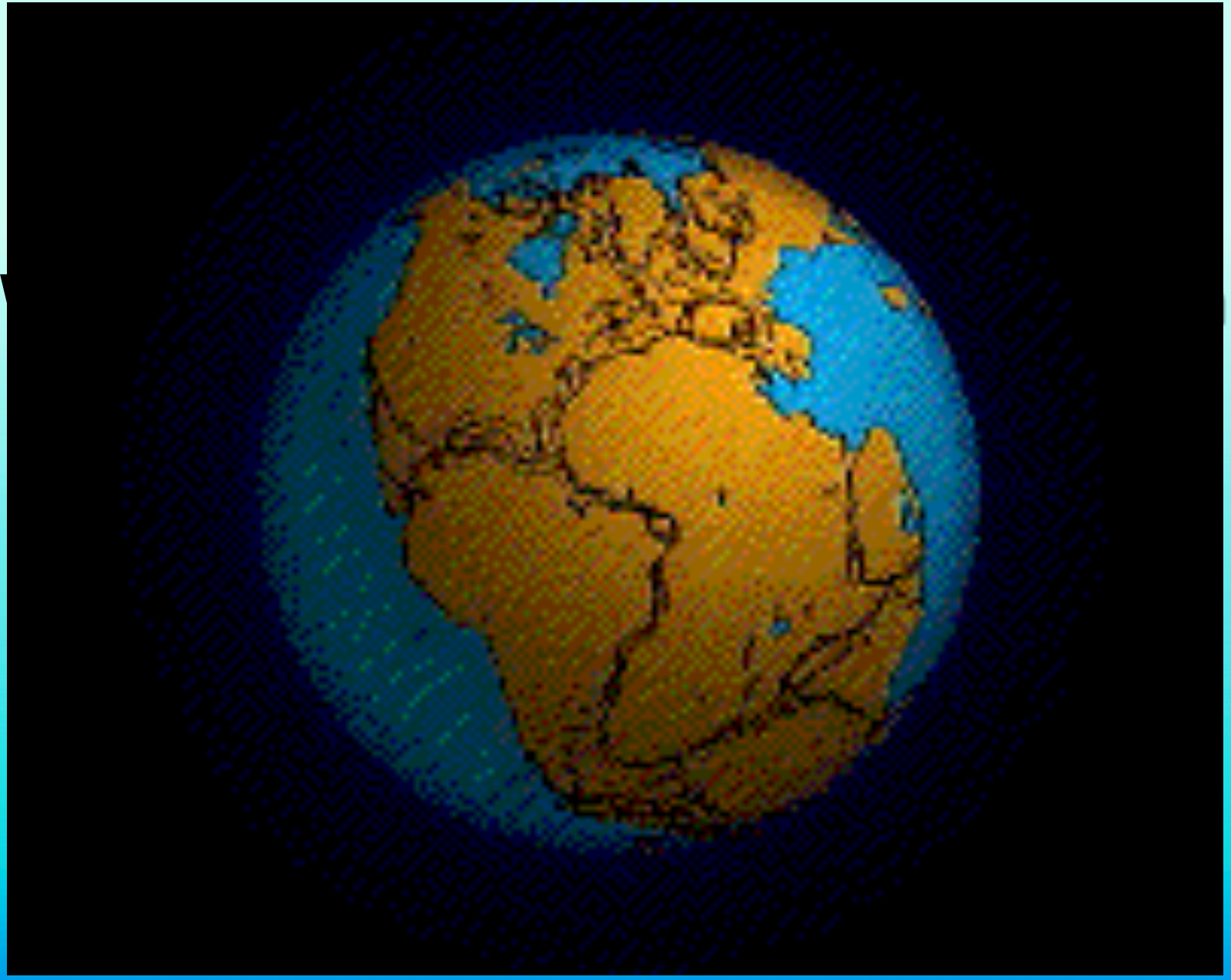
New Vocabulary

Continental drift	**Idea that the continents move very slowly across Earth's surface; the hypothesis was proposed by Alfred Wegener.**
Pangaea	**Ancient supercontinent formed by all modern continents; Pangaea broke apart to become the continents of today.**

Academic Vocabulary

data	**Factual information used as a basis for reading, discussion, or calculation**

Mrs. VanVorhis used data from the experiment to support her hypothesis.



PERMIAN
225 million years ago

TRIASSIC
200 million years ago

JURASSIC
135 million years ago

CRETACEOUS
65 million years ago

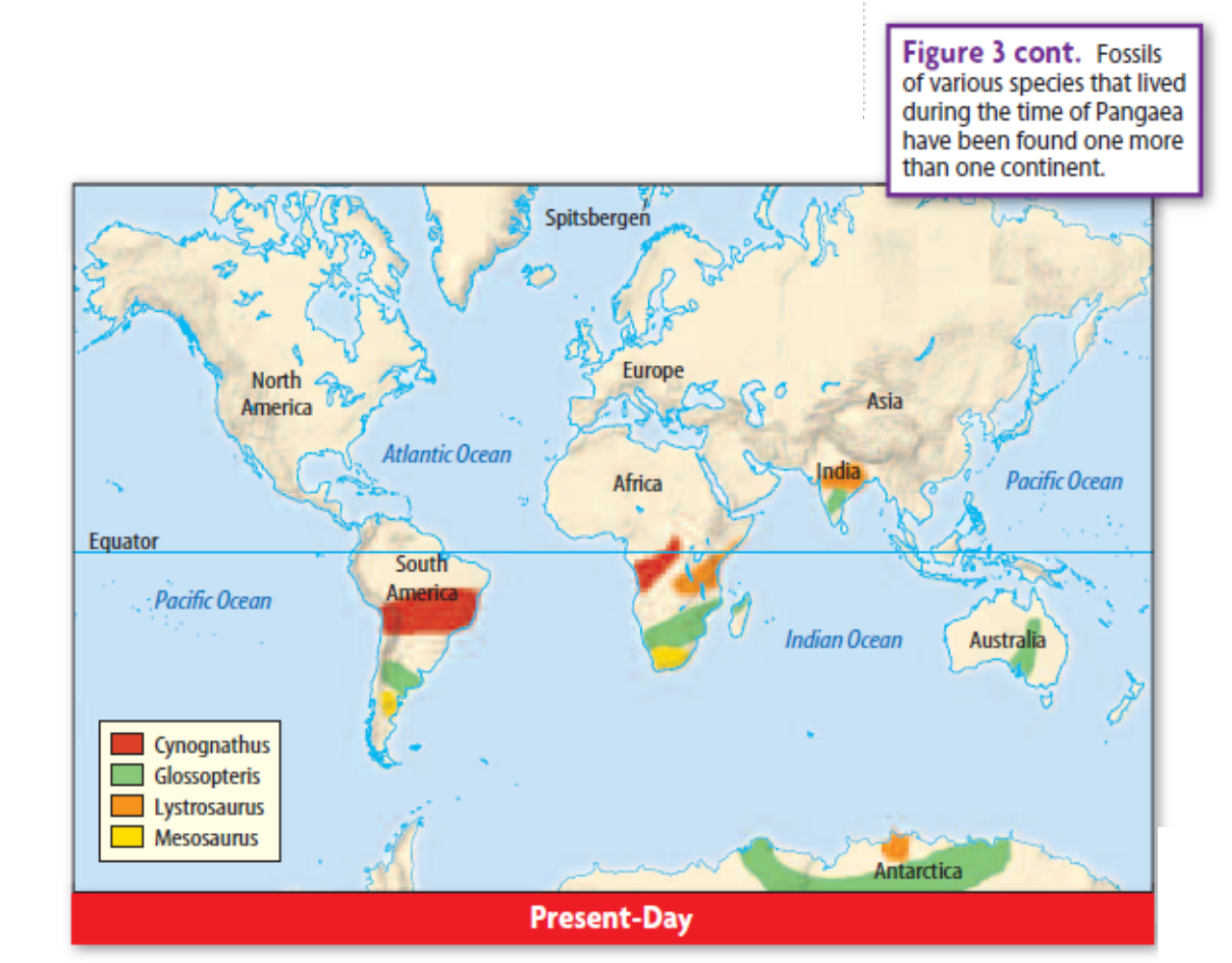
PRESENT DAY

Summarize It

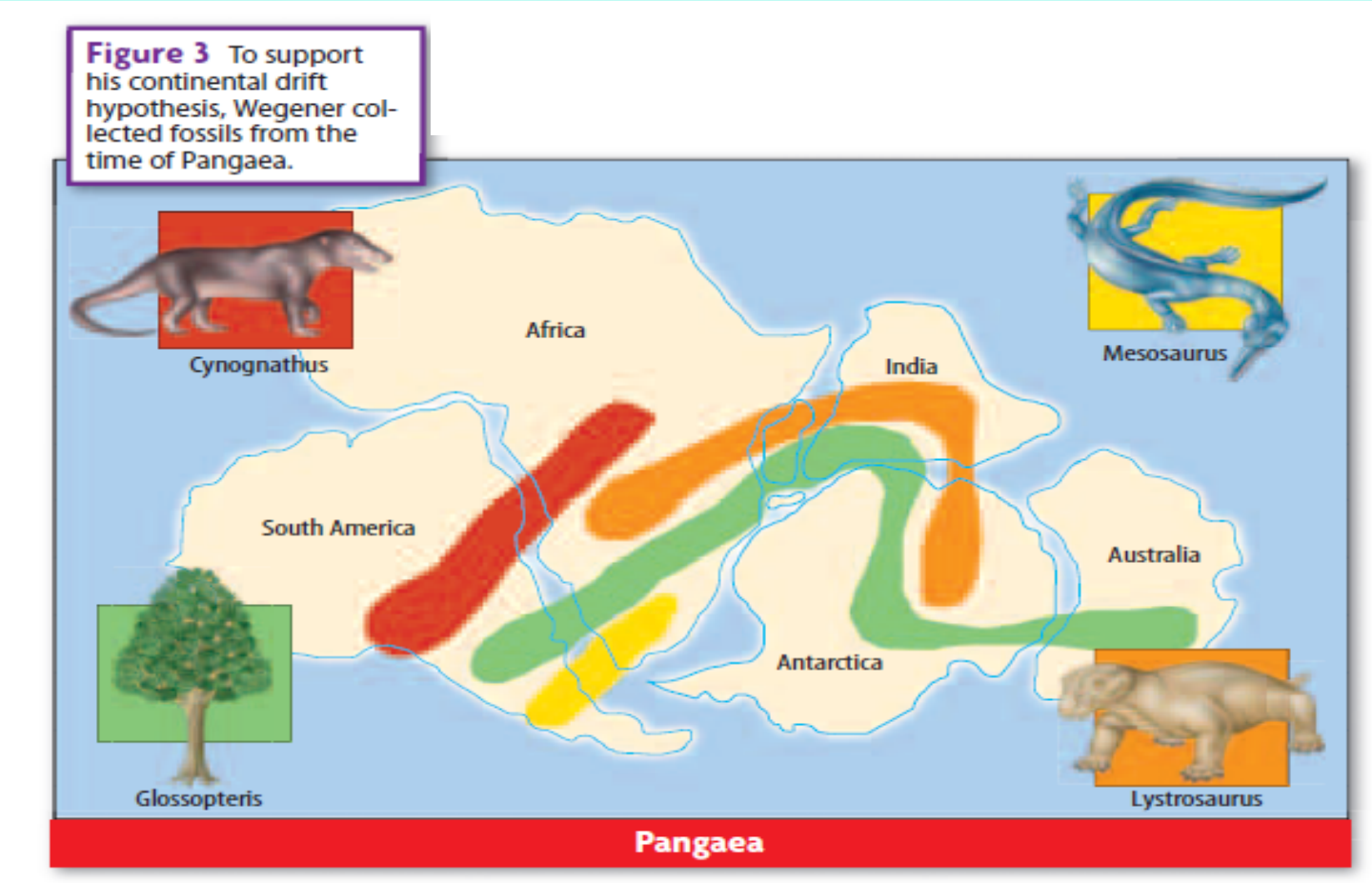
Highlight the main idea of this section in the lesson below.

In the early 1900s, Alfred Wegener proposed a hypothesis to explain why the edges of the continents looked as though they could fit together like pieces of a jigsaw puzzle. Wegener thought that millions of years ago, all of the continents had formed one large landmass called Pangaea. Wegener's hypothesis stated that Pangaea broke apart and the continents slowly drifted to their current locations.

Evidence for Continental Drift



Evidence for Continental Drift



Evidence for Continental Drift

Figure 4 Connecting Landforms Rock types and mountain ranges match up across the continents when they are arranged to form Pangaea.

Evidence for Continental Drift

Figure 5 **Ancient Glaciers** Some rocks located in warm climates today were deposited by glaciers about 300 million years ago.

Explain why rocks formed in tropical climates in Spitsbergen suggest that this island has moved to its present-day location.

Evidence	Description
Fit of Continents	**The edges of continents fit together. The east coast of S. America fits into the notch on the west coast of Africa. NW Africa fits between N. & S. America**
Fossils	**Certain plant and animal fossils can be found on many continents. The organisms couldn't have traveled from one continent to the other if they'd been separated.**
Rock Types	**Groups of rock match up across the Atlantic Ocean. Precambrian rocks in N.A.mer., Greenland, and Europe match up when the continents are together.**
Mountain Ranges	**Some mountain ranges look like they were once connected. The Appalachian Mountains match up with mountains in Greenland, Great Britain, and Scandinavia.**
Ancient Climate	**Rock evidence shows that a different climate existed in some areas at one time. Areas that now have cold climates once had tropical climates.**

A Hypothesis Rejected

Analyze why scientists initially rejected Wegener's hypothesis.

Scientists did not accept Wegener's explanation of the forces that could cause continental drift and couldn't think of a force that was strong enough to move continents.

Summarize It!

Summarize two main ideas of the above sections.

Lesson 2: Seafloor Spreading

New discoveries led to seafloor spreading as an explanation for continental drift.

What you'll learn:

- **Describe new discoveries that led to the seafloor spreading hypothesis.**
- **Explain how seafloor spreading works.**
- **Compare & Contrast evidence for seafloor spreading with evidence for continental drift.**

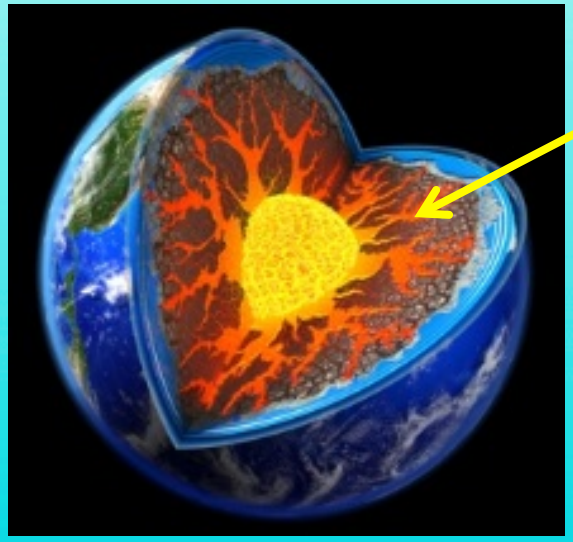
So What?!

The seafloor spreading hypothesis explained continental drift.

Review Vocabulary

magma **Melted rock below earth's surface**

magma



lava

New Vocabulary

Mid-ocean ridge	**Mountain range in the middle of the seafloor.**
Seafloor spreading	**Process by which new floor is continuously made at mid-ocean ridges.**

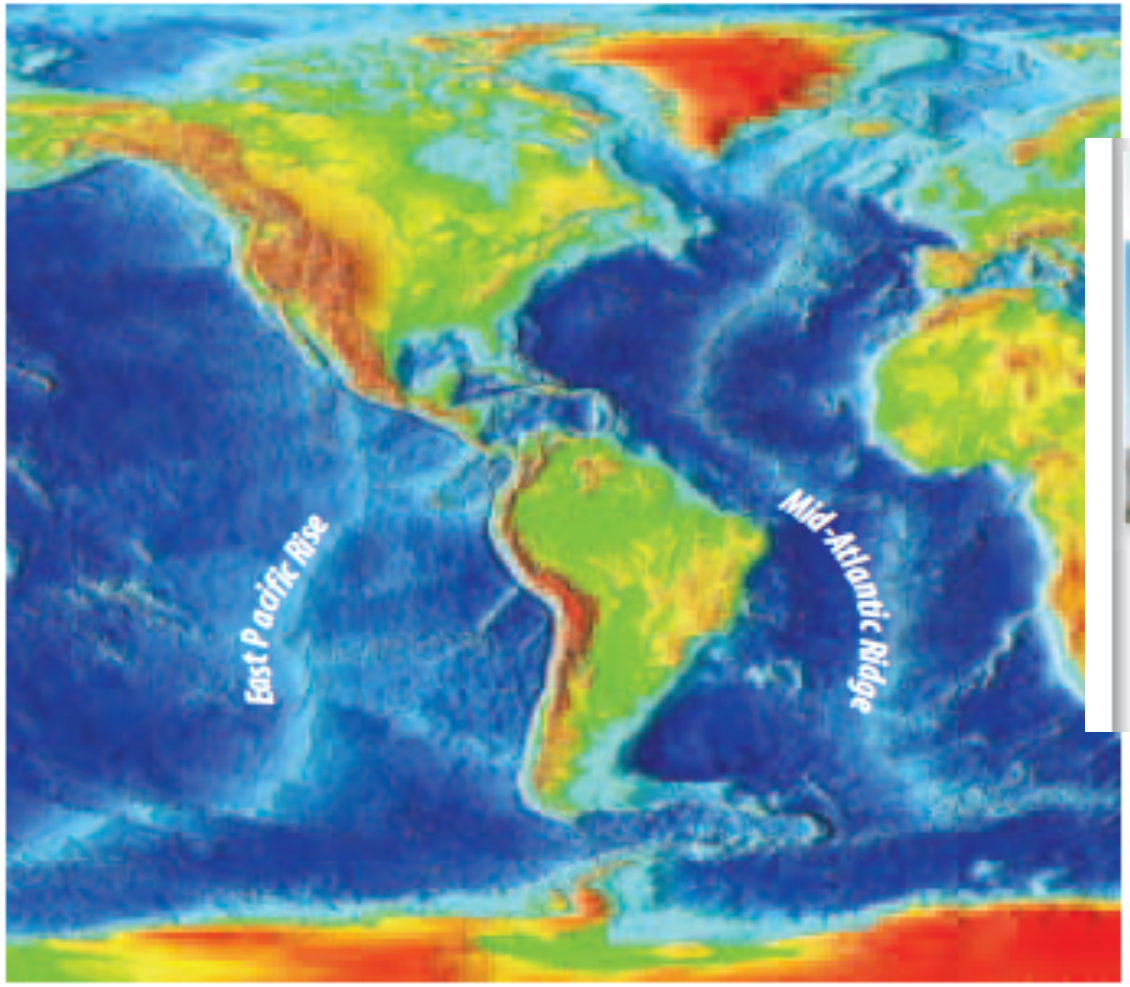
*** Seafloor spreading occurs at mid-ocean ridges, where new oceanic crust is formed.**

Academic Vocabulary

Hypothesis **A tentative explanation that can be tested with a scientific investigation.**

Investigating the Seafloor

Figure 8 **Depth Changes** The light-blue color on the map shows locations with shallow water.



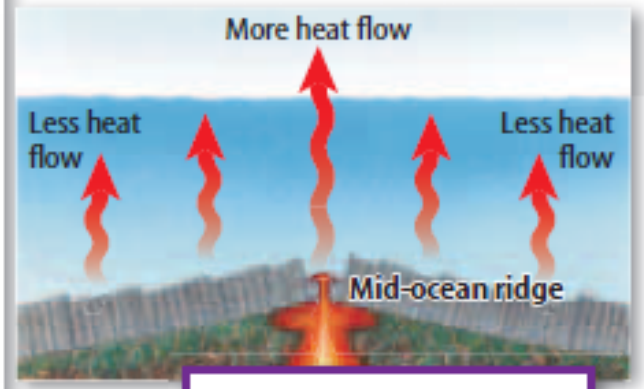


Figure 9 The flow of heat from the mantle increases the closer you get to a mid-ocean ridge.

Investigating the Seafloor

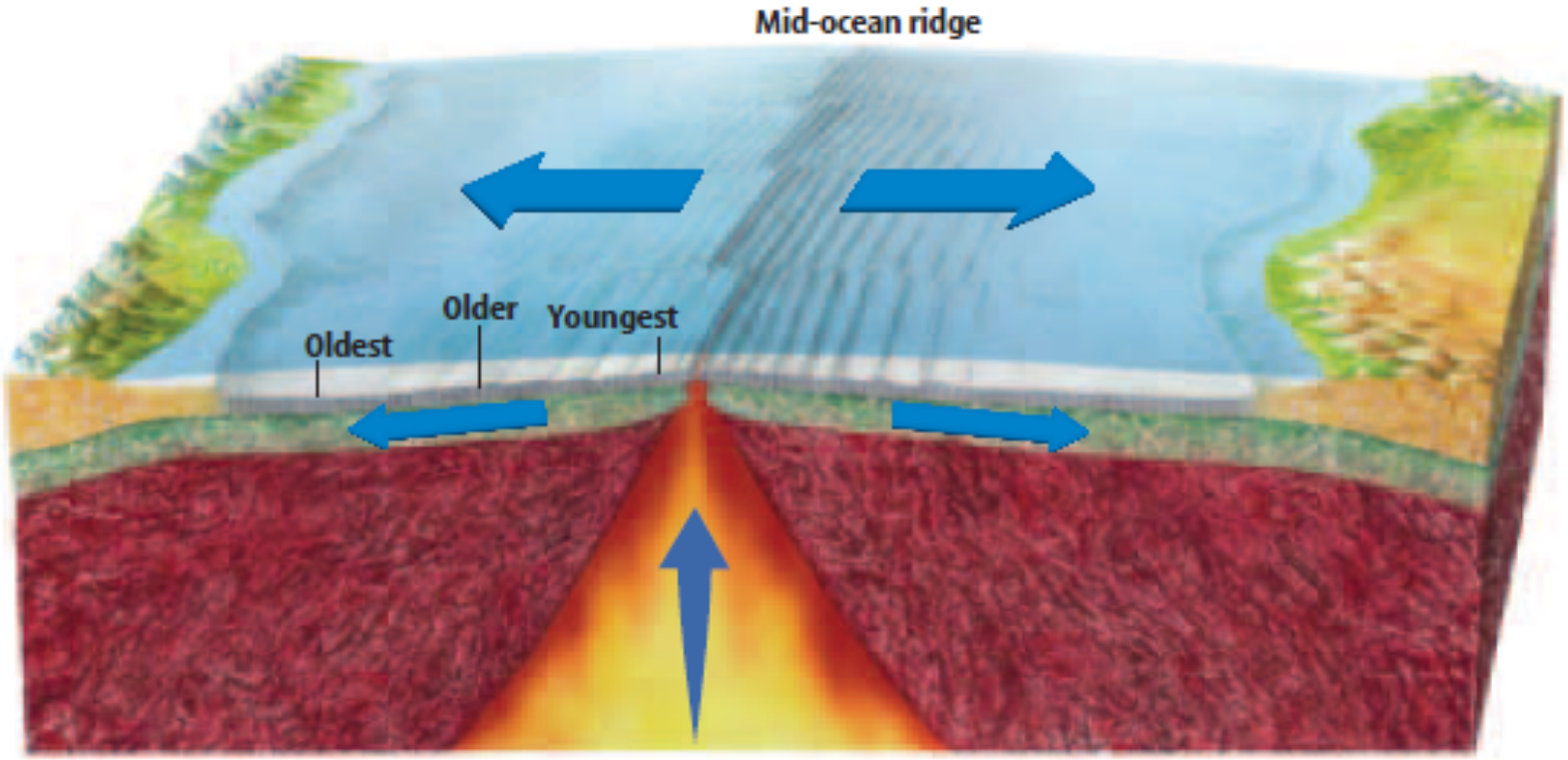
Summarize discoveries scientists have made from studying the seafloor.

Mountain ranges called mid-ocean ridges wrap around Earth. More heat escapes from Earth at mid-ocean ridges than at other locations in the oceans.

The Seafloor Moves

Model the process of seafloor spreading.

Figure 10 Seafloor spreading forms new oceanic crust. The older oceanic crust moves away from the ridge as new oceanic crust forms.



Evidence for Spreading

Identify the position of Earth's magnetic poles today and when they are reversed.

N

S

Normal

S

N

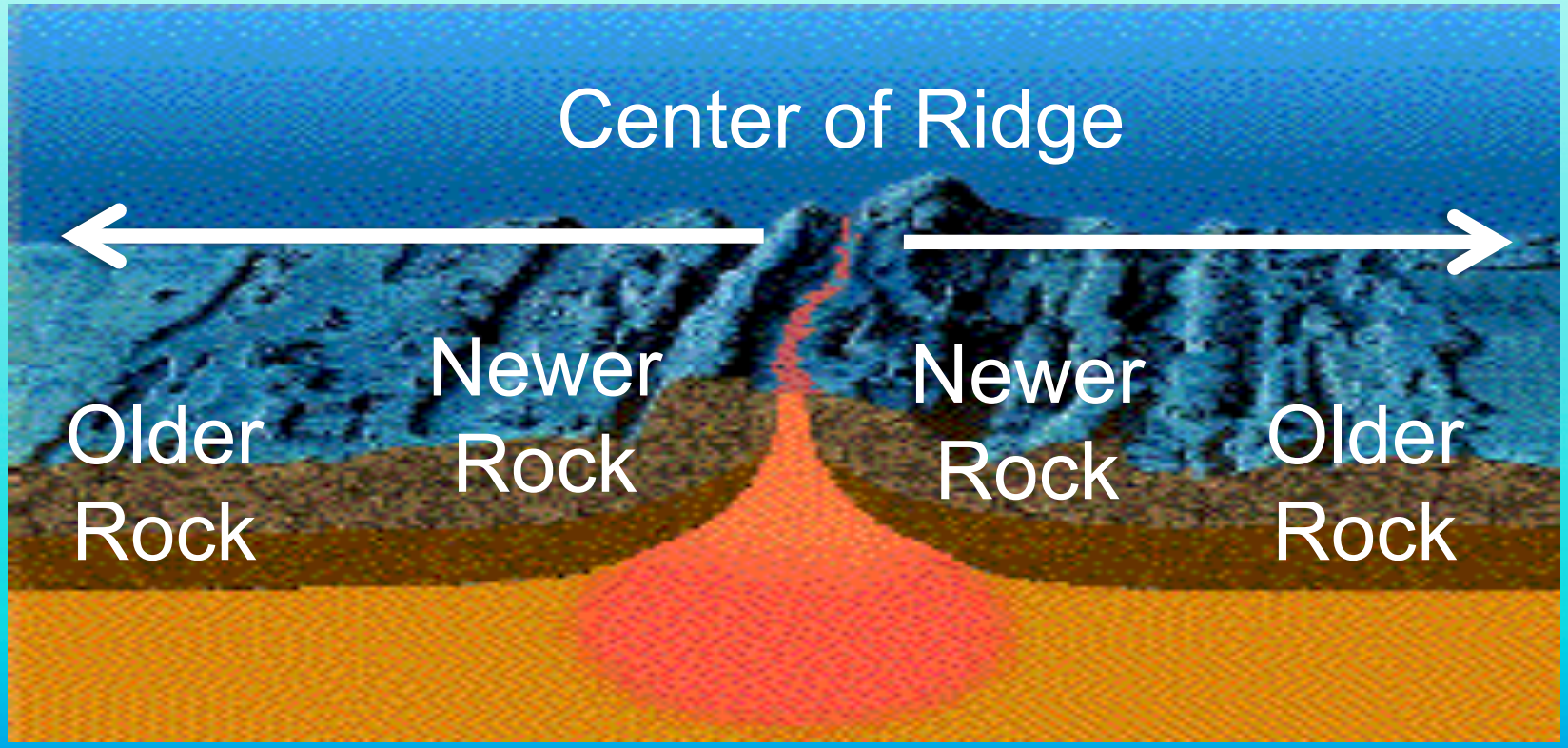
Reversed

Summarize It!

Summarize two main ideas of the above sections with two bullet points.

Evidence for Spreading

Label the diagram to show what scientists learned from studying magnetic reversals.



Evidence for Spreading

How have scientists used seafloor drilling to provide evidence for seafloor spreading?

I. Methods

A. Boat called Glomar Challenger designed to take samples.

B. Diamond-tipped drill cut through rock to get samples.

II. Results

A. Oldest rocks farthest from mid-ocean ridge

B. Youngest rocks in center of mid-ocean ridge

Summarize It!

Highlight the main idea of this section below.

Scientists use information from Earth's magnetic pole reversals to determine the age of basalt rock on the seafloor. This has provided evidence for seafloor spreading. The youngest rock is found closest to mid-ocean ridges, and the oldest rock is found farthest away.

Lesson 3: Theory of Plate Tectonics

Earth's lithosphere is broken into large, brittle pieces, which move as a result of forces acting on them.

What you'll learn:

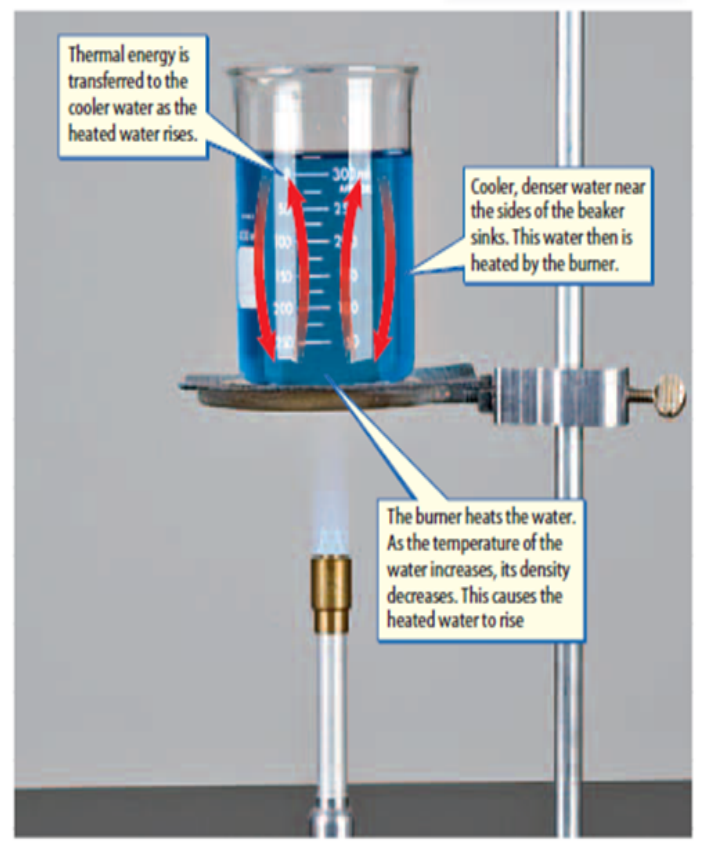
- **Summarize the theory of plate tectonics.**
- **Determine common locations of earthquakes, volcanoes, & mid-ocean ridges.**
- **Compare and contrast oceanic and continental lithosphere.**

So What?!

Plate tectonics cause major geologic features of Earth's crust and contribute to the recycling of material.

Review Vocabulary

convection



Heat transfer by the movement of matter from one place to another.

Convection only occurs in fluids: liquids and gasses.

New Vocabulary

Lithospheric Plate	**Large, brittle piece of Earth's outer shell.**
Plate Tectonics	**Theory that explains how lithospheric plates move and cause major geologic features and events on Earth's surface**

New Vocabulary

Ocean Trench	**Long, deep parts of the seafloor**
Slab	**Plate that sinks back into the mantle**

Academic Vocabulary

Define **To fix or mark the limits of**

*** The area is <u>defined</u> by steep, rocky mountains.**

Earth's Plates

Figure 15 Earth's brittle crust is cracked and broken into pieces. The red lines show about where major cracks are located on Earth.

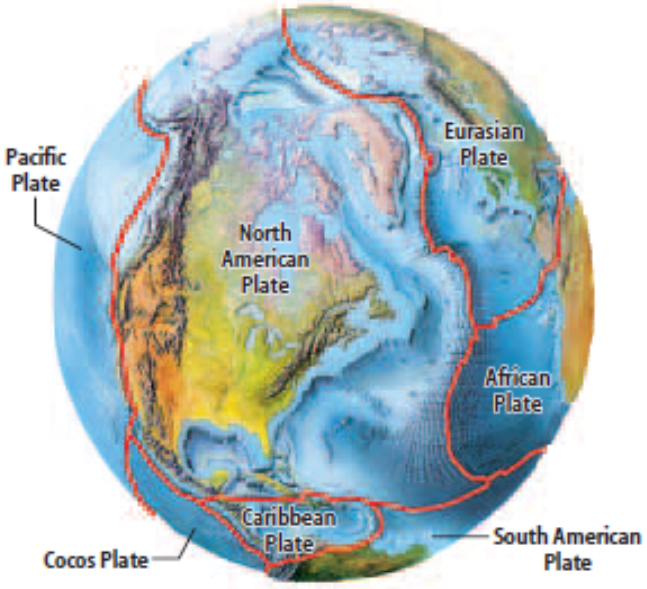
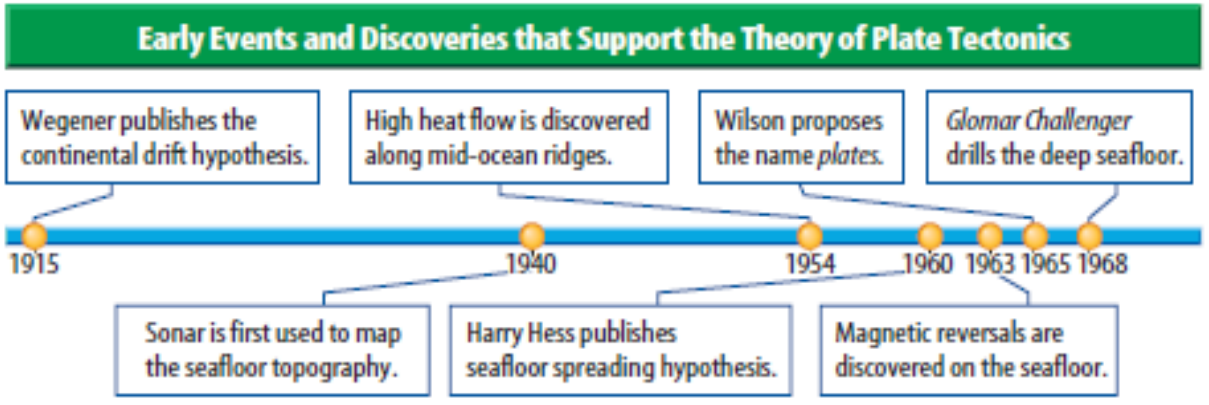


Figure 16 You probably live on the North American Plate, one of the major lithospheric plates shown on this map.

Figure 17 Important studies from scientists around the world contributed to the development of the theory of plate tectonics.



Earth's Plates

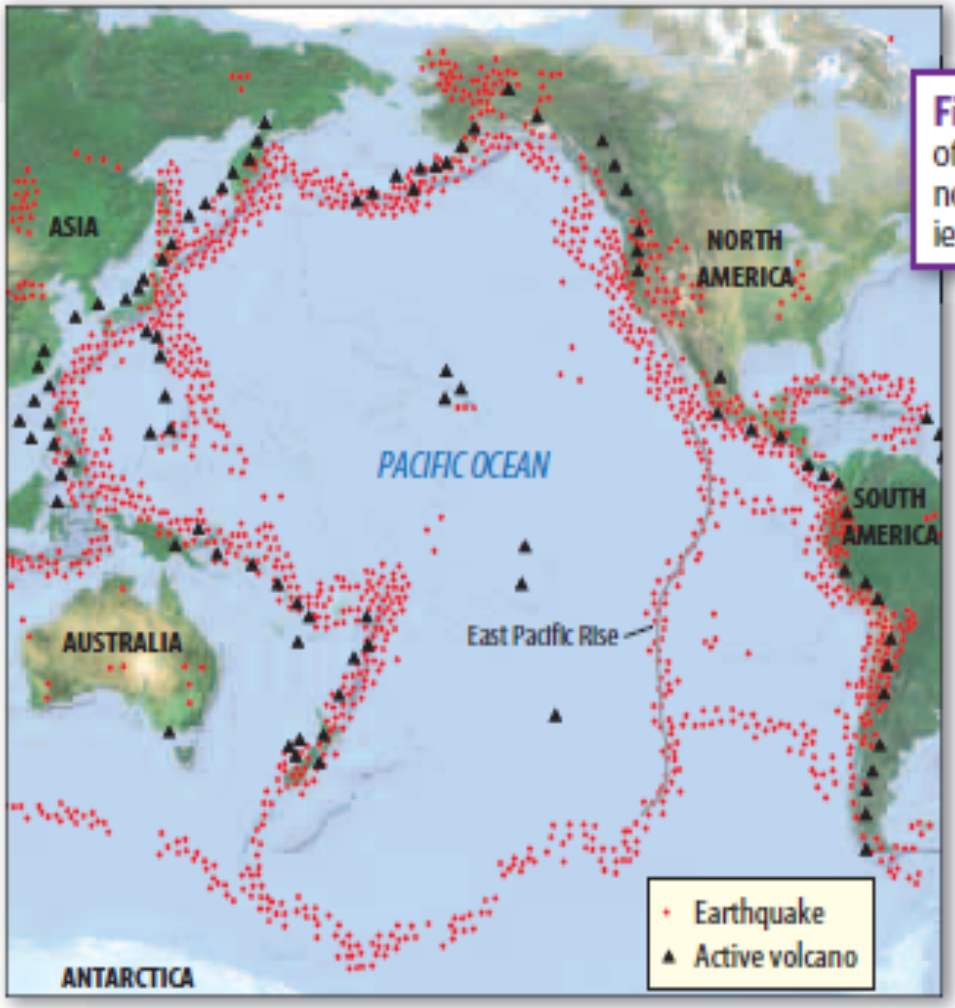
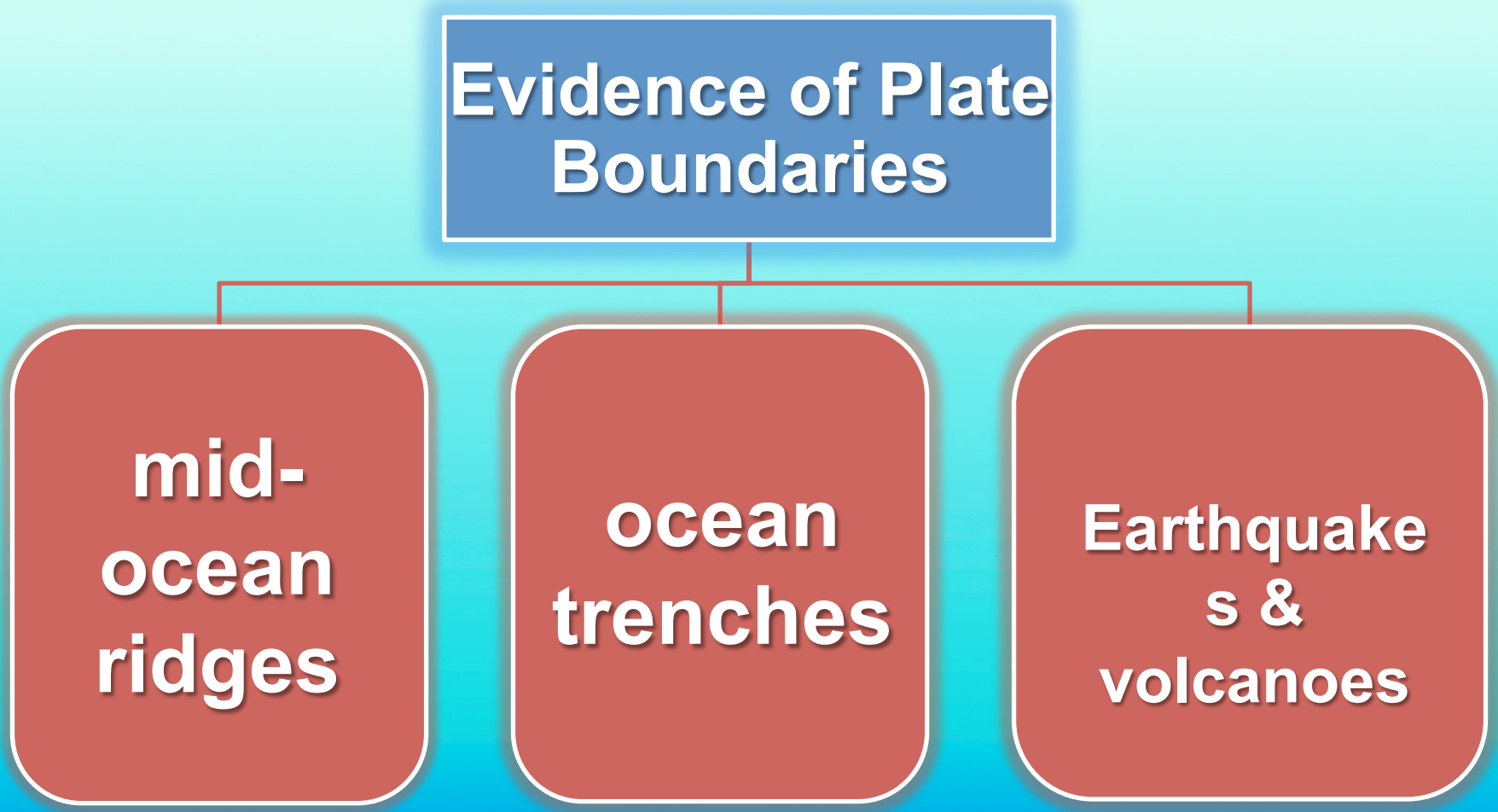


Figure 18 The locations of earthquakes and volcanoes indicate the boundaries of lithospheric plates.

Earth's Plates

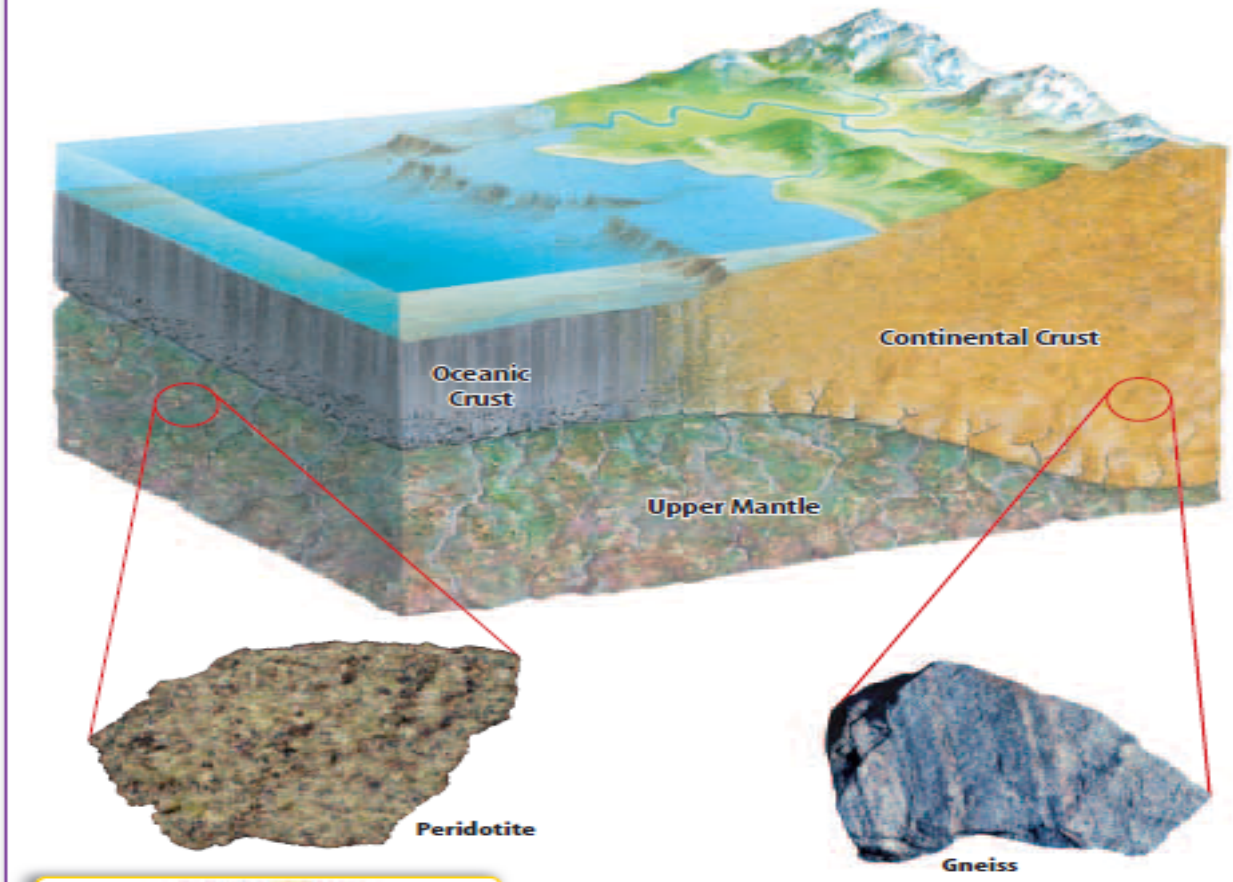
Organize evidence for plate boundaries on Earth.



Types of Lithosphere

Table 1 Types of Lithosphere

Type of Lithosphere	Components	Common Rocks	Approximate Densities
Oceanic	• oceanic crust • upper mantle	• crust: basalt, gabbro • upper mantle: peridotite	• crust: 3.0 g/cm^3 • mantle: 3.3 g/cm^3
Continental	• continental crust • upper mantle	• crust: granite, gneiss, sedimentary rocks • upper mantle: peridotite	• crust: 2.65 g/cm^3 • mantle: 3.3 g/cm^3



Types of Lithosphere

Identify and Describe the two different types of lithosphere.

Types of Lithosphere

Continental

- Thicker than oceanic
- Made of igneous and metamorphic rock covered by sedimentary rock.

Oceanic

- Thinner than continental
- Made of dense igneous rock covered by a thin layer of sediment.

Plate Movement: Escaping Heat

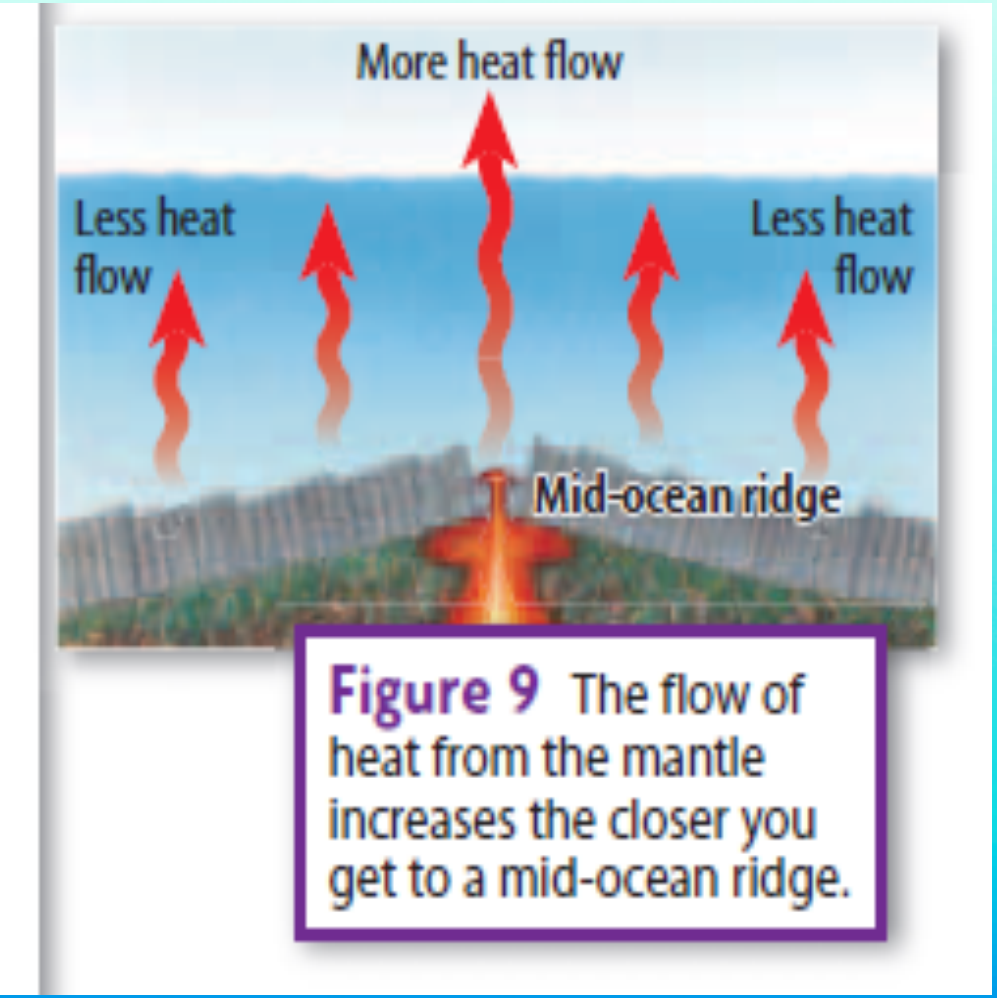


Figure 9 The flow of heat from the mantle increases the closer you get to a mid-ocean ridge.

Plate Movement: Internal Heat Source

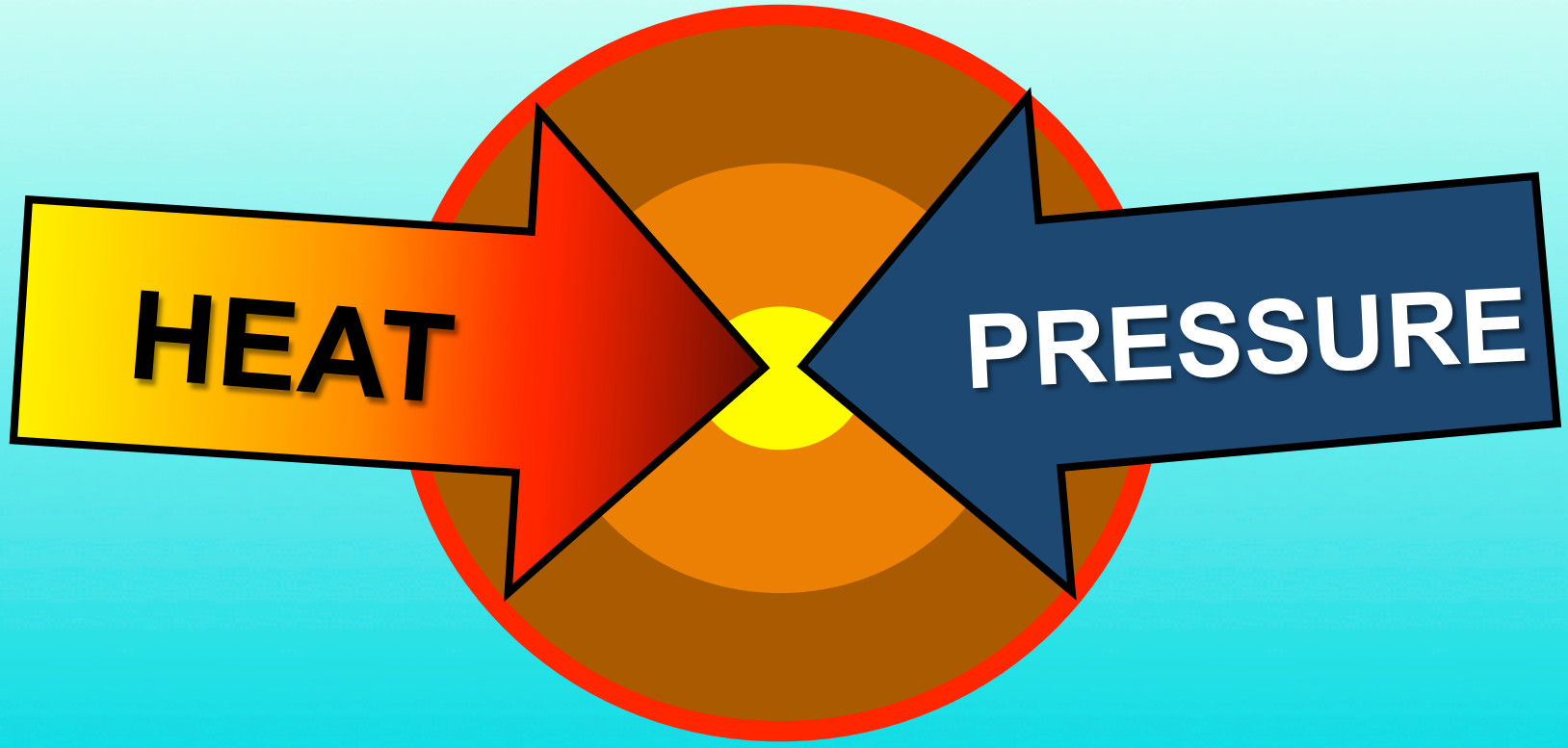


Plate Movement: Convection

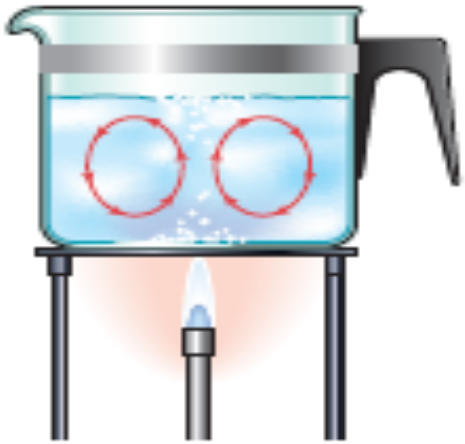


Figure 19 The flame heats water at the bottom of the pot. The warm water rises, then as it cools, it sinks back down.

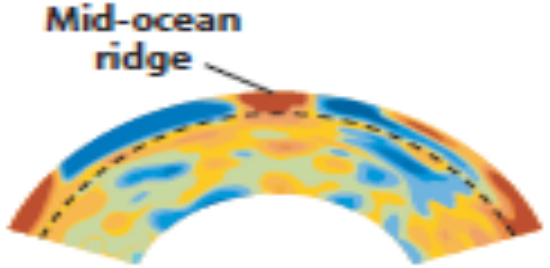


Figure 20 Scientists model the locations of warm and cool regions in Earth's interior by studying the behavior of complex waves that travel through them. Red areas shown here are relatively warm, and blue areas are relatively cool.

What Controls Plate Movement?

Summarize how forces within Earth affect plates.

Type of Force	Effect
Convection	**Cooler, denser masses of rock sink, bringing plates with them. Less-dense rock is brought to the surface at mid-ocean ridges.**
Ridge Push	**The force of gravity moves the plate downward and away from mid-ocean ridges.**
Slab Pull	**Gravity acts on denser plates, pulling them into the mantle.**

Summarize It!

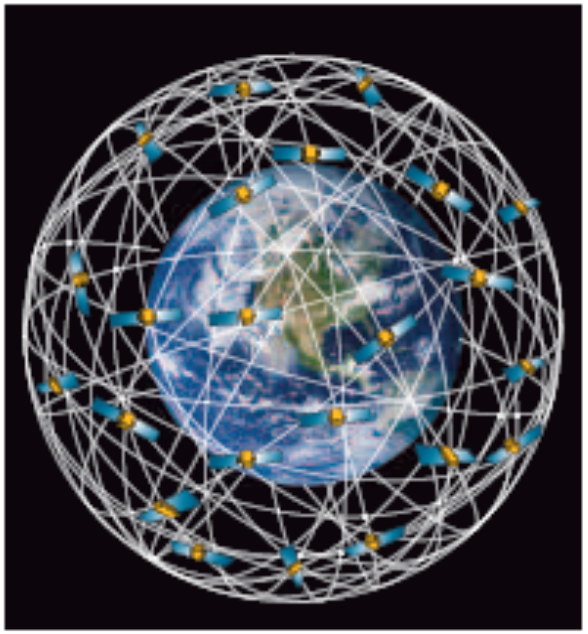
Summarize two main ideas of the above sections.

Measuring Plate Movement

Explain how satellites are used to measure the movement of plates.

GPS (Global Positioning System) is a network of satellites that uses radio waves to measure the direction and speed of plates as they move along Earth's surface.

Figure 23 This diagram shows the orbits of the 24 GPS satellites that orbit 20,000 km above Earth.



Measuring Plate Movement

Explain how satellites are used to measure the movement of plates.

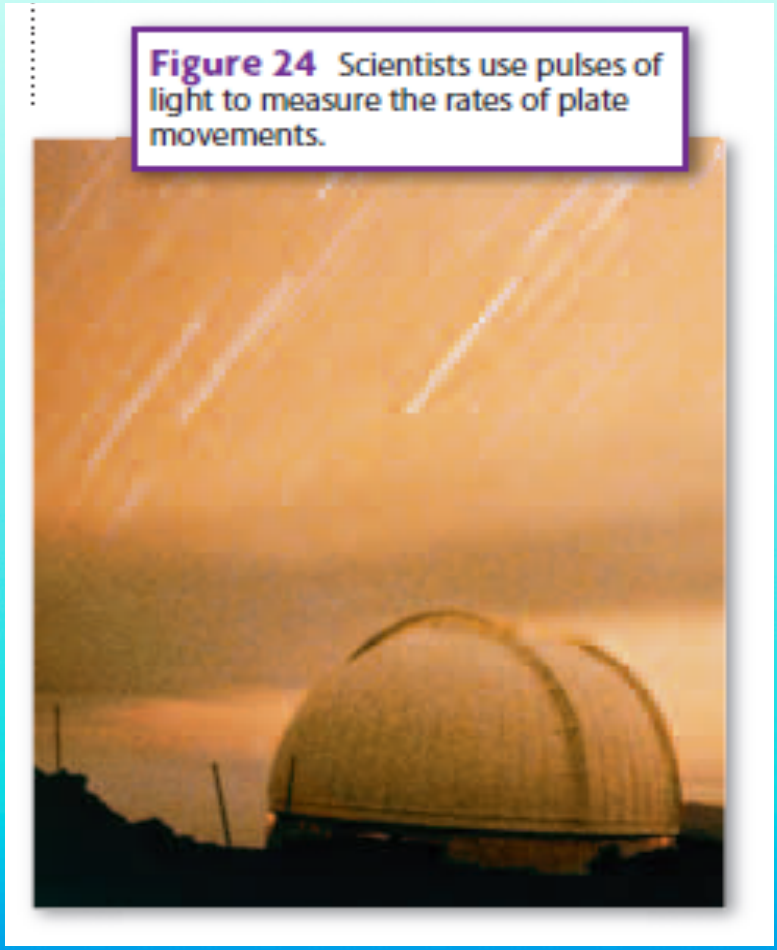
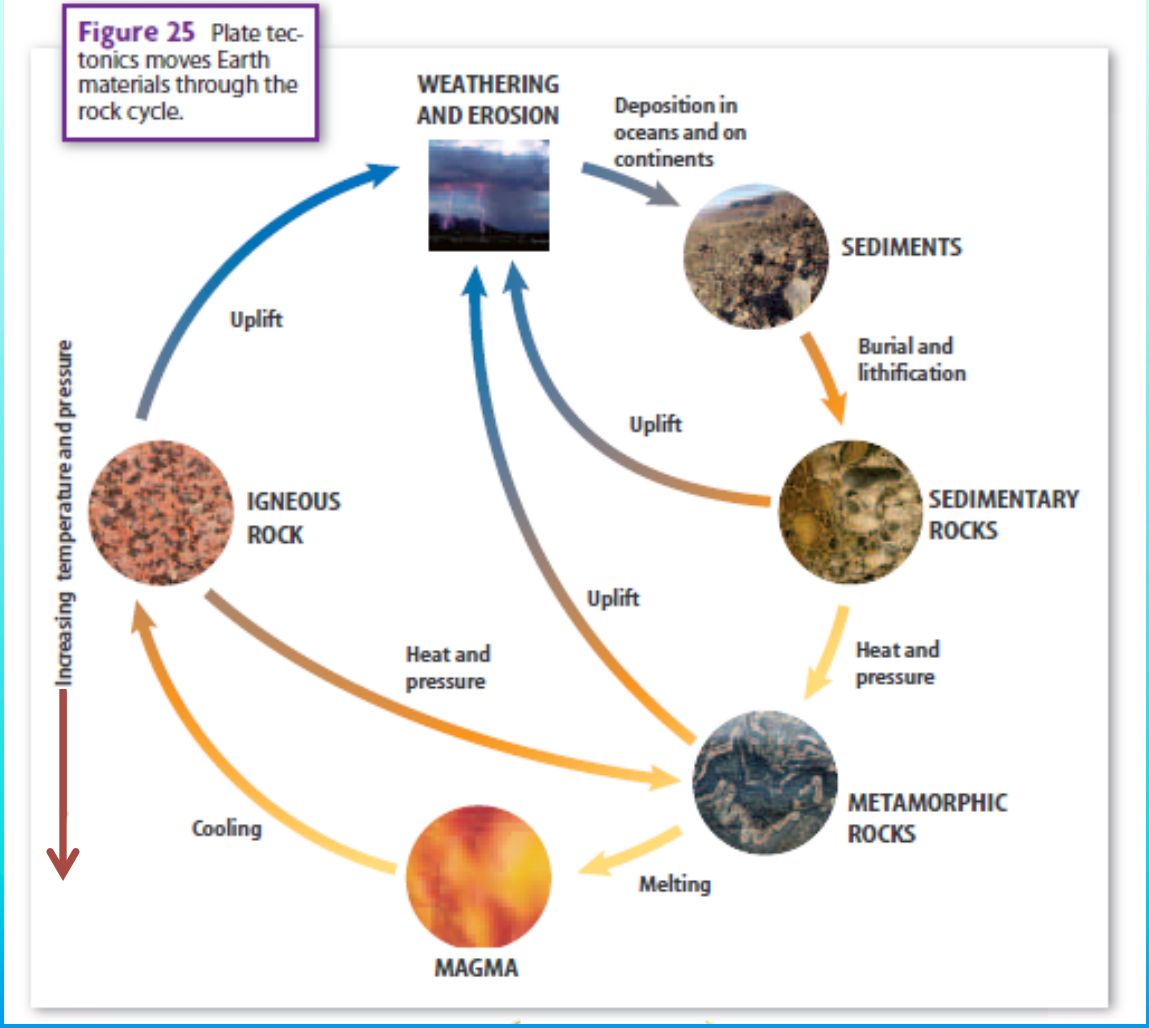


Figure 24 Scientists use pulses of light to measure the rates of plate movements.

Another satellite system, SLR (satellite laser ranging), uses laser beams to measure distances of plate movement.

Plate Tectonics & the Rock Cycle

Create a diagram showing how plate tectonics moves materials through the rock cycle.



Summarize It!

Summarize three main ideas of the above sections.