SECTION 2

READING WARM-UP

## Terms to Learn

continental drift
sea-floor spreading

## What You'll Do

- Describe Wegener's theory of continental drift, and explain why it was not accepted at first.
- Explain how sea-floor spreading provides a way for continents to move.
- Describe how new oceanic crust forms at mid-ocean ridges.
- Explain how magnetic reversals provide evidence for sea-floor spreading.

# Restless Continents

Take a look at **Figure 7.** It shows how continents would fit together if you removed the Atlantic Ocean and moved the land together. Is it just coincidence that the coastlines fit together so well? Is it possible that the continents were actually together sometime in the past?

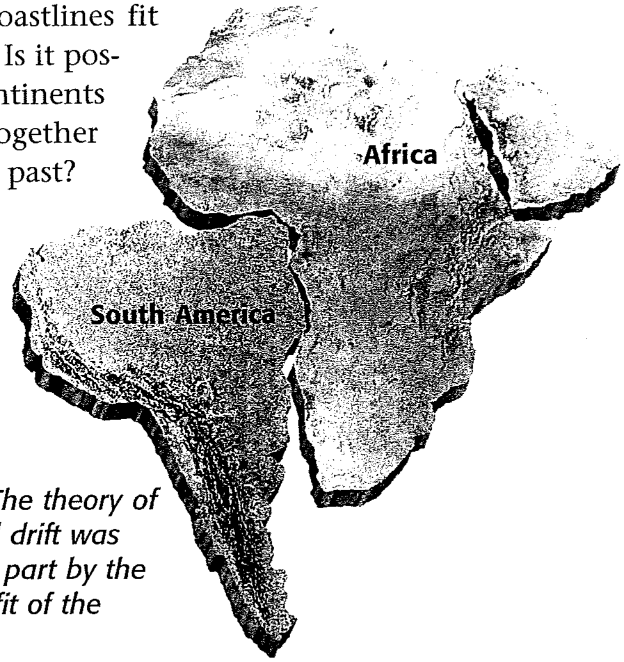
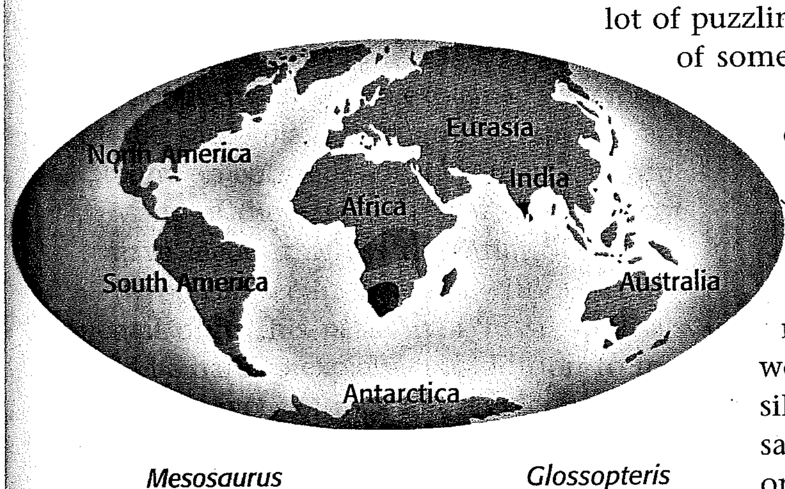



**Figure 7** *The theory of continental drift was inspired in part by the puzzlelike fit of the continents.*

## Wegener's Theory of Continental Drift

One scientist who looked at the pieces of this puzzle was Alfred Wegener (VEG e nuhr). In the early 1900s he wrote about his theory of *continental drift.* **Continental drift** is the theory that continents can drift apart from one another and have done so in the past. This theory seemed to explain a lot of puzzling observations, including the very good fit of some of the continents.

Continental drift also explained why fossils of the same plant and animal species are found on both sides of the Atlantic Ocean. Many of these ancient species could not have made it across the Atlantic Ocean. As you can see in **Figure 8,** without continental drift, this pattern of fossil findings would be hard to explain. In addition to fossils, similar types of rock and evidence of the same ancient climatic conditions were found on several continents.




*Mesosaurus*

*Glossopteris*

**Figure 8** *Fossils of* Mesosaurus, *a small, aquatic reptile, and* Glossopteris, *an ancient plant species, have been found on several continents.*

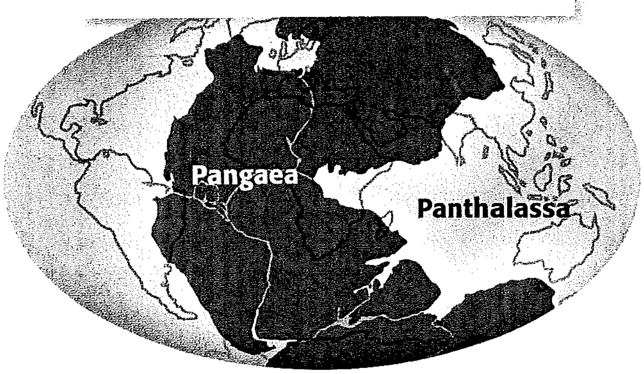
Continental drift also explained puzzling evidence left by ancient glaciers. Glaciers cut grooves in the ground that indicate the direction they traveled. When you look at the placement of today's continents, these glacial activities do not seem to be related. But when you bring all of these continental pieces back to their original arrangement, the glacial grooves match! Along with fossil evidence, glacial grooves supported Wegener's idea of continental drift.

## The Breakup of Pangaea

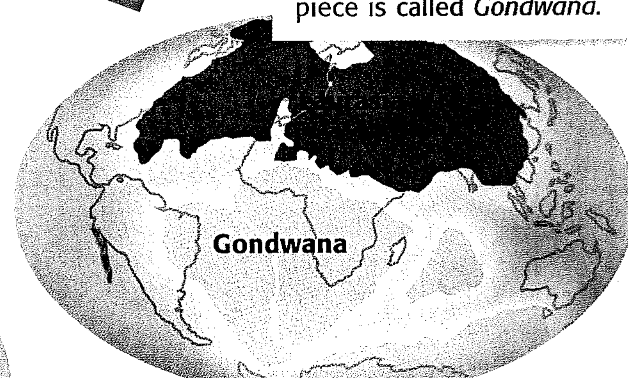
Wegener studied many observations before establishing his theory of continental drift. He thought that all the separate continents of today were once joined in a single landmass that he called *Pangaea,* which is Greek for "all earth." As shown in **Figure 9,** almost all of Earth's landmasses were joined together in one huge continent 245 million years ago.

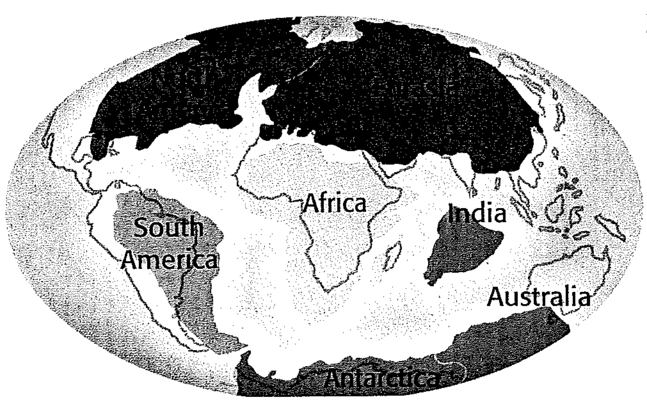
**Figure 9** *Over time, Earth's continents have changed shape and traveled great distances.*

**245 Million Years Ago** Pangaea existed when some of the earliest dinosaurs were roaming the Earth. It was surrounded by a sea called *Panthalassa,* meaning "all sea."




**180 Million Years Ago** Gradually Pangaea broke into two big pieces. The northern piece is called *Laurasia.* The southern piece is called *Gondwana.*




**65 Million Years Ago** By the time the dinosaurs became extinct, Laurasia and Gondwana had split into smaller pieces.

## Sea-Floor Spreading

When Wegener put forth his theory of continental drift, many scientists would not accept his theory. What force of nature, they wondered, could move entire continents? In Wegener's day, no one could answer that question. It wasn't until many years later that new evidence provided some clues.

In **Figure 10** you will notice that there is a chain of submerged mountains running through the center of the Atlantic Ocean. The chain is called the Mid-Atlantic Ridge, part of a worldwide system of ocean ridges. Mid-ocean ridges are underwater mountain chains that run through Earth's ocean basins.

*Mid-ocean ridges* are places where sea-floor spreading takes place. **Sea-floor spreading** is the process by which new oceanic lithosphere is created as older materials are pulled away. As tectonic plates move away from each other, the sea floor spreads apart and magma rises to fill in the gap. Notice in **Figure 11** that the crust increases in age the farther it is from the mid-ocean ridge. This is because new crust continually forms from molten material at the ridge. The oldest crust in the Atlantic Ocean is found along the edges of the continents. It dates back to the time of the dinosaurs. The newest crust is in the center of the ocean. This crust has just formed!

**Figure 10** *The Mid-Atlantic Ridge is part of the longest mountain chain in the world.*

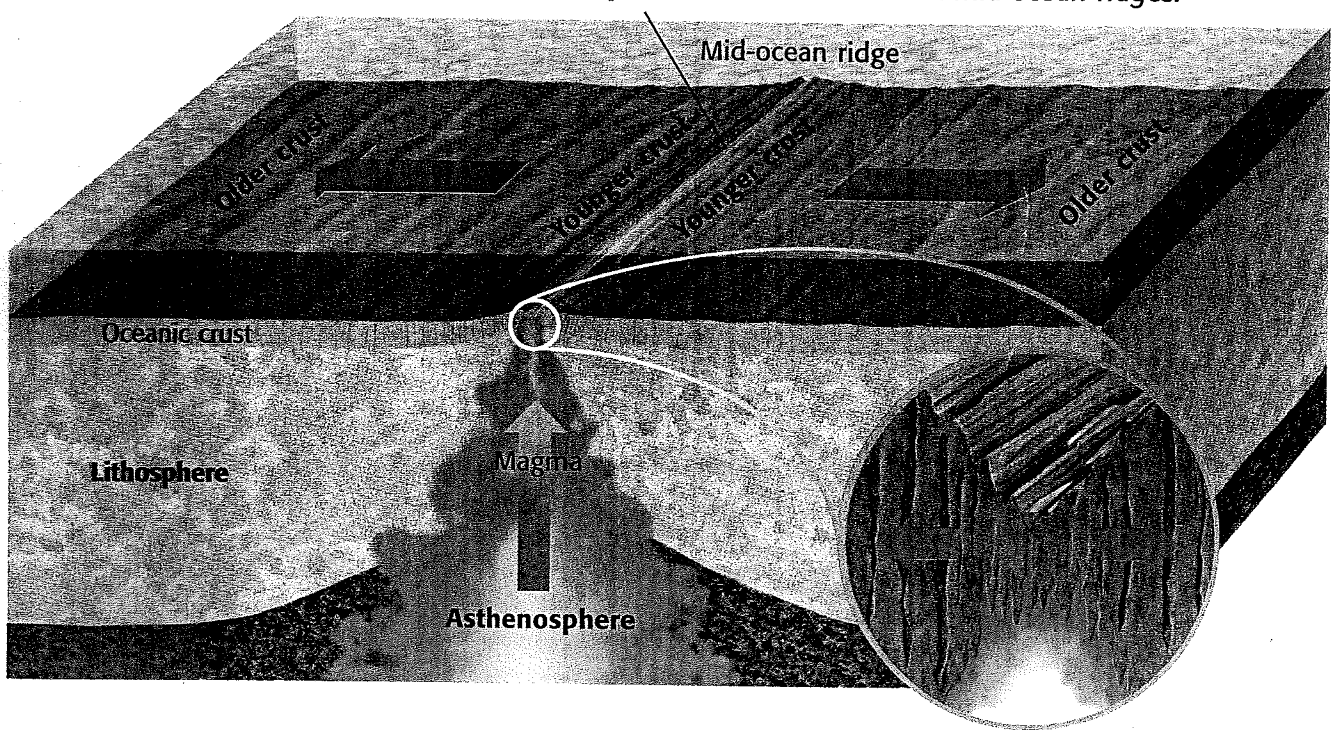



**Figure 11** *Sea-floor spreading creates new oceanic lithosphere at mid-ocean ridges.*

## Magnetic Reversals

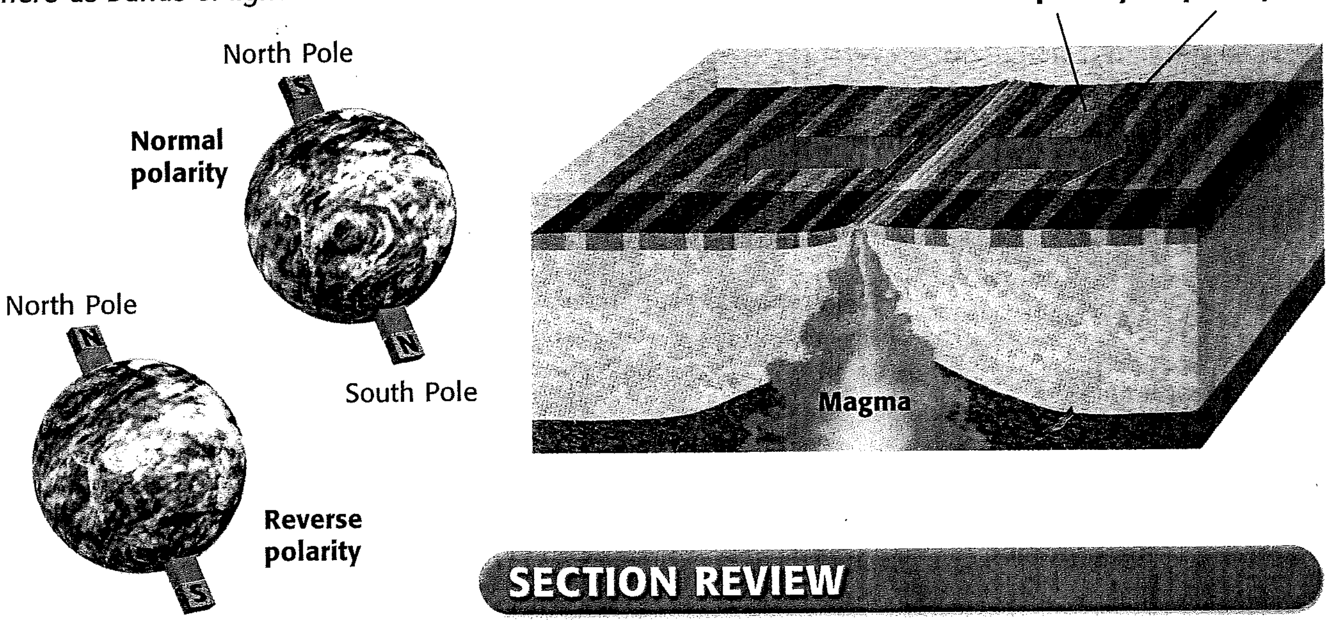
**Physics CONNECTION**

All matter has the property of magnetism, though in most cases it is very weak compared with that of magnets. This explains why researchers have been able to levitate a frog—by creating a very strong magnetic field beneath it!

Some of the most important evidence of sea-floor spreading comes from magnetic reversals recorded in the ocean floor. Throughout Earth's history, the north and south magnetic poles have changed places many times. When Earth's magnetic poles change place, this is called a *magnetic reversal.*

The molten rock at the mid-ocean ridges contains tiny grains of magnetic minerals. These mineral grains act like compasses. They align with the magnetic field of the Earth. Once the molten rock cools, the record of these tiny compasses is literally set in stone. This record is then carried slowly away from the spreading center as sea-floor spreading occurs. As you can see in **Figure 12,** when the Earth's magnetic field reverses, a new band is started, and this time the magnetic mineral grains point in the opposite direction. The new rock records the direction of the Earth's magnetic field. This record of magnetic reversals was the final proof that sea-floor spreading does occur.

**Figure 12** *Magnetic reversals in oceanic crust are shown here as bands of light and dark blue oceanic crust.*




## SECTION REVIEW

1. List three puzzling occurrences that the theory of continental drift helped to explain, and describe how it explained them.
2. Explain why Wegener's theory of continental drift was not accepted at first.
3. **Identifying Relationships** Explain how the processes of sea-floor spreading and magnetic reversal produce bands of oceanic crust that have different magnetic polarities.