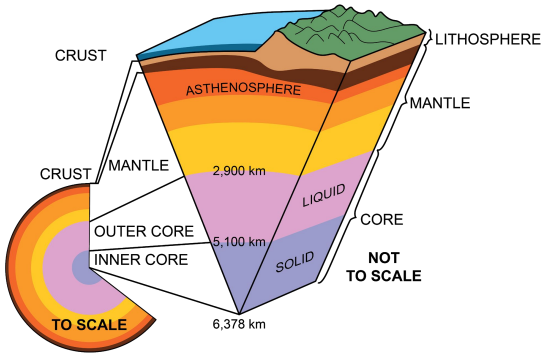
Plate Tectonics

Reflect

Have you ever wondered how mountains form? What about forces of nature such as volcanoes or earthquakes? The answers to these questions are found in the layers of Earth and the concept of plate tectonics!



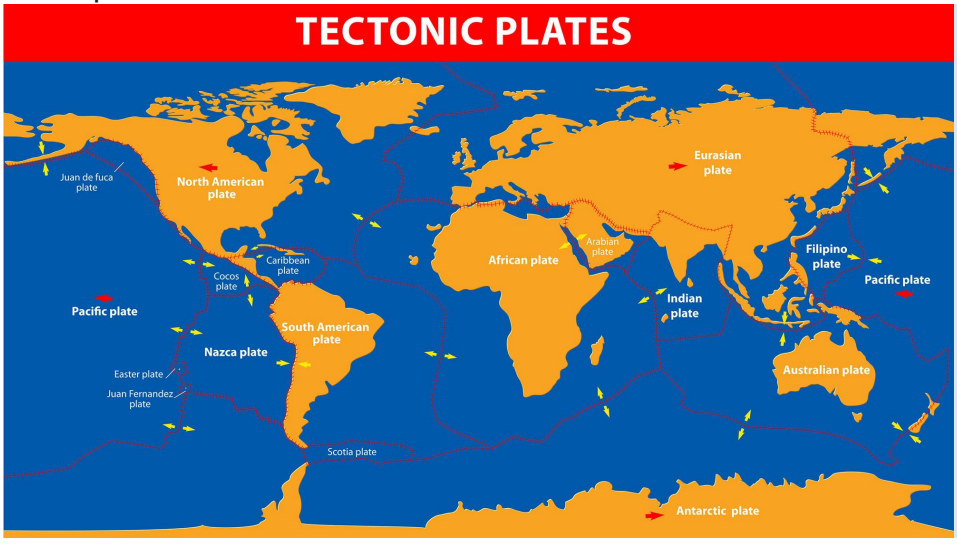
The crust is the top layer of Earth's surface, and the core is the center layer. A thick layer of **molten** rock can be found between the crust and core. This layer of molten rock is known as the mantle. The **lithosphere** is made up of Earth's crust and the uppermost part of the mantle. Cool and rigid, the lithosphere is the outermost layer of Earth and is broken into large, thick pieces called **tectonic plates**. These tectonic plates contain different kinds of crust, oceanic and continental. Both are less dense than the mantle, but oceanic crust is denser than continental crust. This is one reason why continents are higher than the ocean floor. However, some continental plates are submerged in the ocean, and some oceanic plates, such as the entirety of Iceland, are above the ocean.

lithosphere – consists of the crust (light brown) and upper mantle (dark brown)

molten – melted; liquefied

tectonic plates – the broken pieces of the lithosphere that move on the asthenosphere

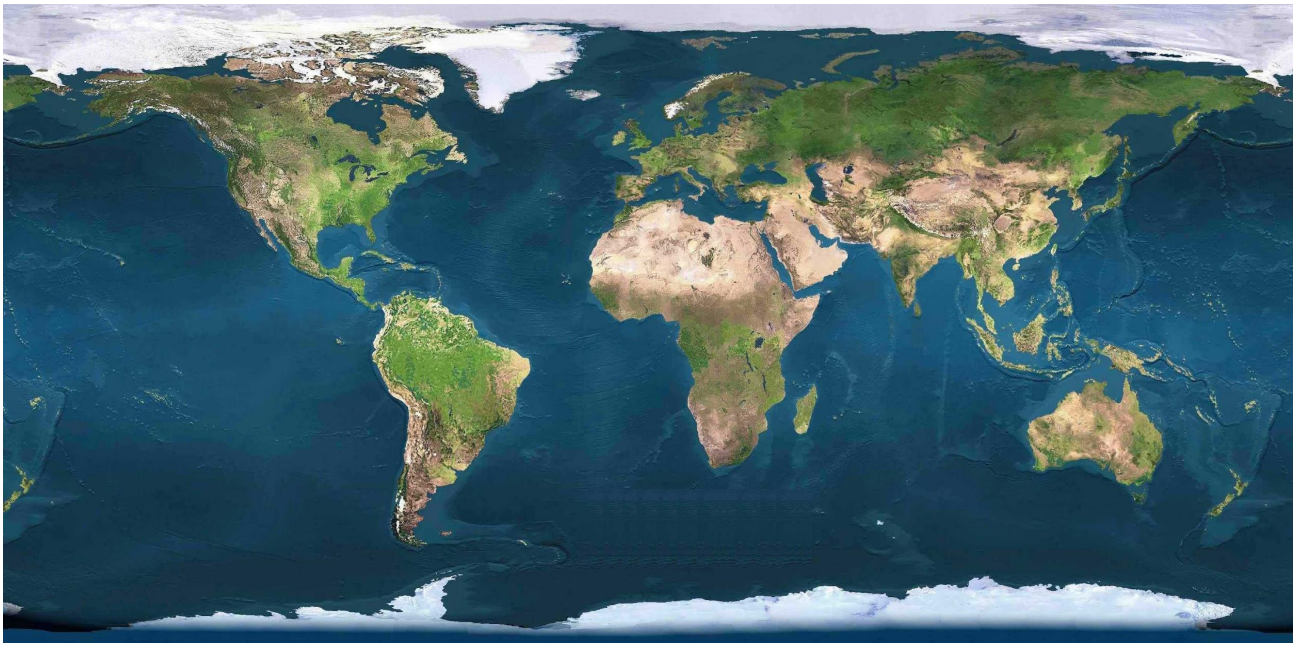
Scientists have given names to Earth's tectonic plates. This map shows the current major tectonic plates. Many of these plates are named for the continents or oceans they support. Maps of ancient land and water patterns show how Earth's plates have moved great distances, collided, and spread apart.



Earth's major tectonic plates include the African Plate, Antarctic Plate, Eurasian Plate, Indian Plate, Australian Plate, North American Plate, South American Plate, and Pacific Plate.

How did they discover that the tectonic plates had moved? Was that movement related to Earth structures such as mountains, valleys, or volcanoes?

Look at the world map and notice the shapes of the continents. Do you see how some continents appear to fit together like the pieces of a jigsaw puzzle? Why do you think this is? Is it just a coincidence, or do you think it suggests something important about the history of our planet?



What Do You Think?

Continental Drift

If you noticed that the continents appear to fit together like a jigsaw puzzle, you're not alone. In the early 20th century, a German scientist named Alfred Wegener noticed this phenomenon. Wegener hypothesized that at one or more points in Earth's history, the continents were connected. Wegener looked for further evidence that the continents might have been connected and might have moved over time.

Evidence of Continental Movement

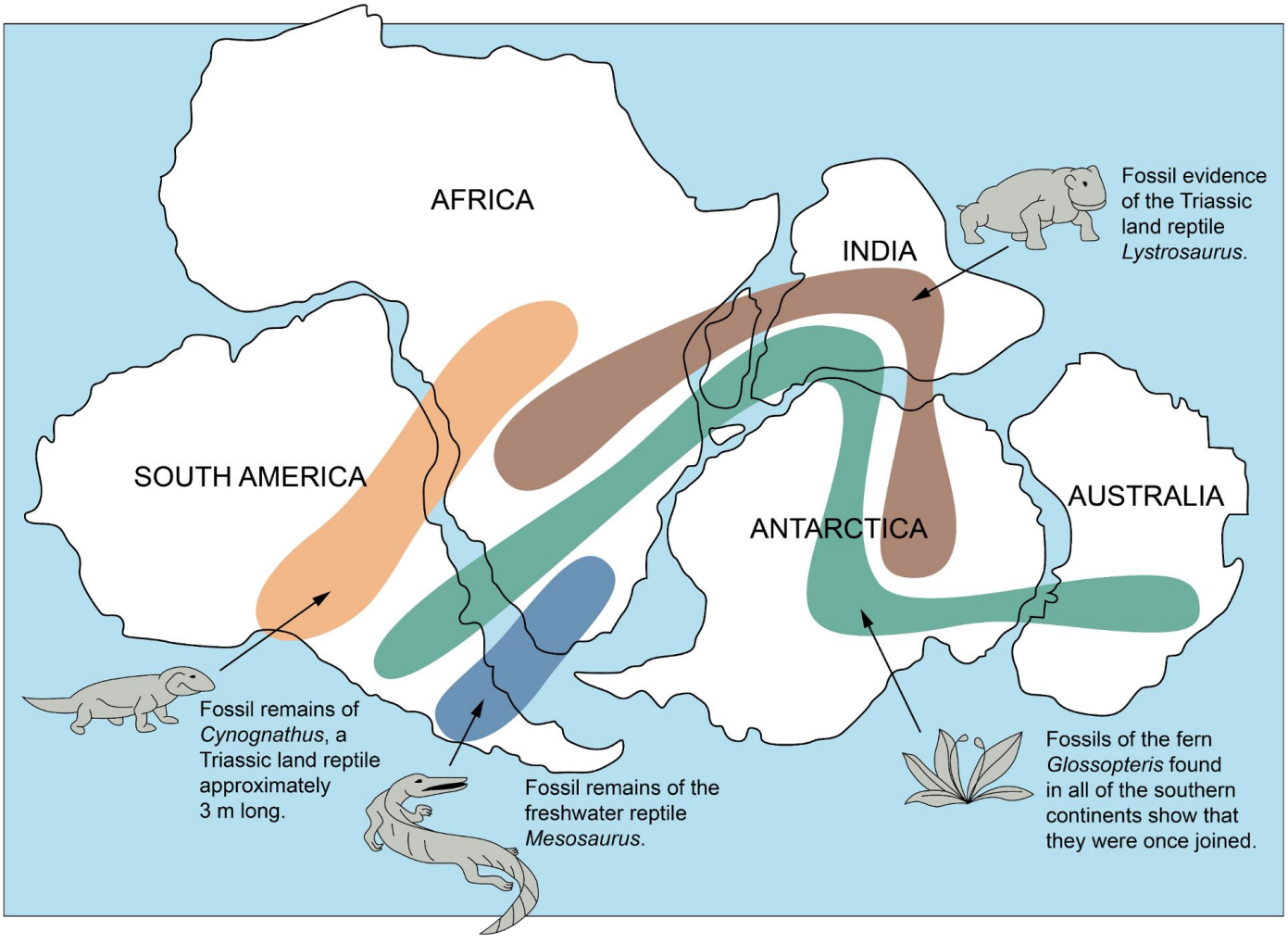
Matching geologic structures: Wegener looked for other connections between the matching coastlines. Where coastlines appeared to fit together, he noticed that certain geologic formations also appeared to fit together. For example, a mountain range on one coastline appeared to connect with a mountain chain on the opposite coastline. Several deposits of sediment left behind by glaciers also lined up along the matching coastlines of continents.

Reflect

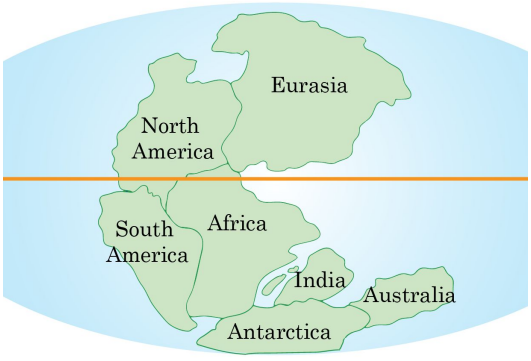
Matching-fossils evidence: In addition to geological evidence, Wegener found fossil evidence that the continents may once have been connected.

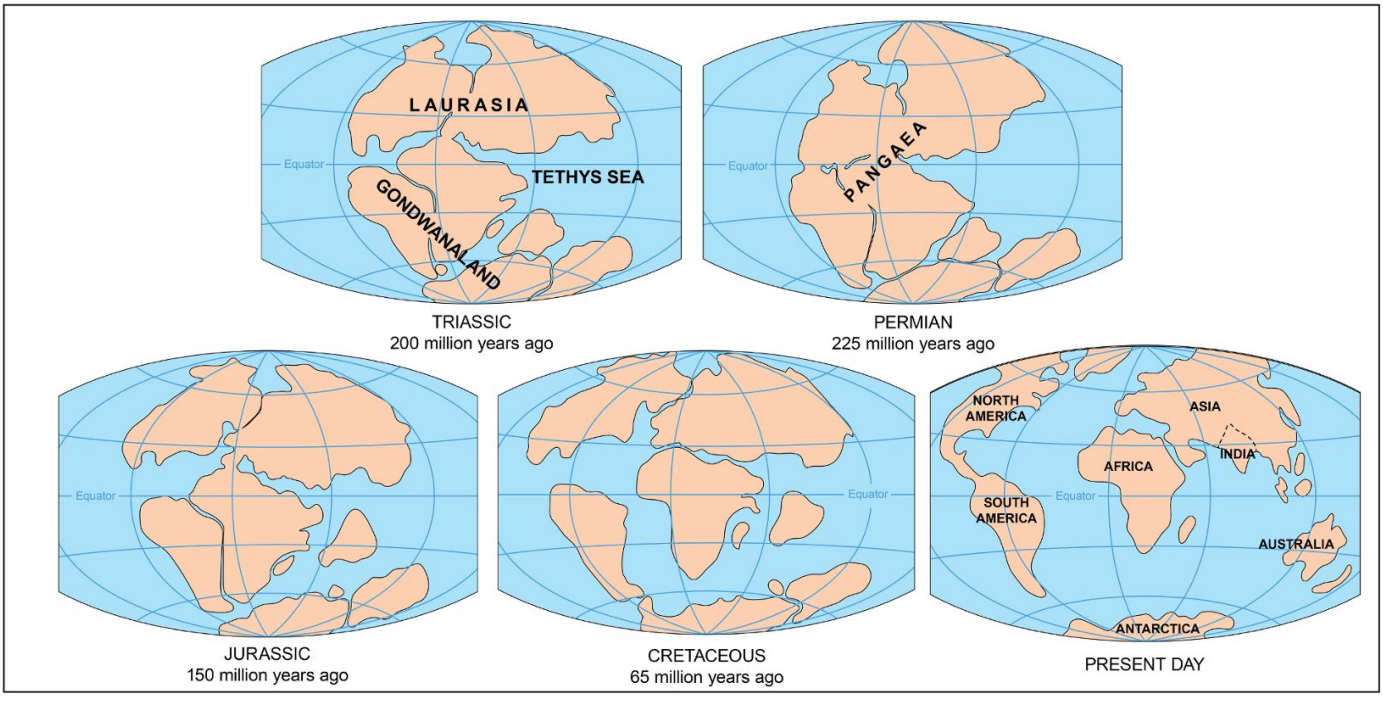
Fossils of a freshwater reptile called *Mesosaurus* were found on both the eastern coast of South America and the western coast of South Africa. It is highly unlikely that these freshwater animals swam across the entire Atlantic Ocean while they were alive.

Fossils of a land reptile called *Lystrosaurus* were also found along matching coasts of eastern Africa, central India, and Antarctica. These land animals also could not have crossed the oceans separating these continents. Equally unlikely is the possibility that the same species evolved independently on multiple continents. Instead, Wegener reasoned that the continents must have been joined at one time. As the continents moved apart, they took mesosaurus and lystrosaurus fossils with them.



Wegener concluded from his findings that the continents must move over time. Scientists gave the process its more familiar name: *continental drift*. At least once in Earth's history, the continents were connected in large landmasses, or supercontinents. Around 250 million years ago, all the continents were connected in one giant supercontinent. Wegener named this supercontinent *Pangaea*, which means "all the Earth." Over millions of years, the continents moved apart to their present-day positions.





Look Out!

Wegener on his expedition in Greenland, trying to prove his hypothesis

Despite the evidence Wegener collected, he could not provide a theory explaining *how* the continents moved over time. Partly for this reason, his hypothesis was initially rejected by the scientific community.

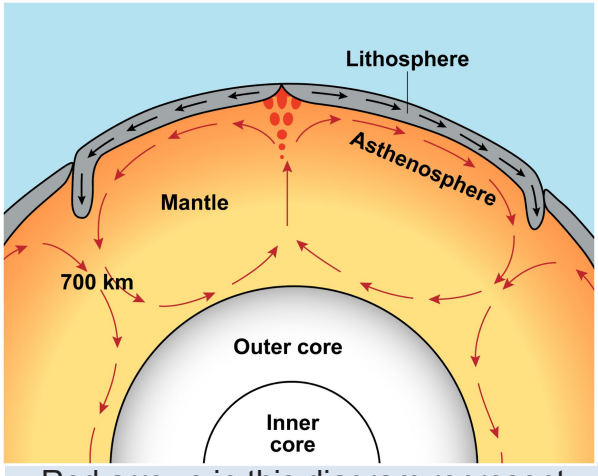
Then, in the 1940s, scientists discovered new evidence concerning seafloor spreading that suggested how continents drift. Unfortunately, Wegener did not live to see his work validated. He froze to death on an expedition across the Greenland ice cap, trying to prove his hypothesis.

Reflect

Convection currents move tectonic plates.

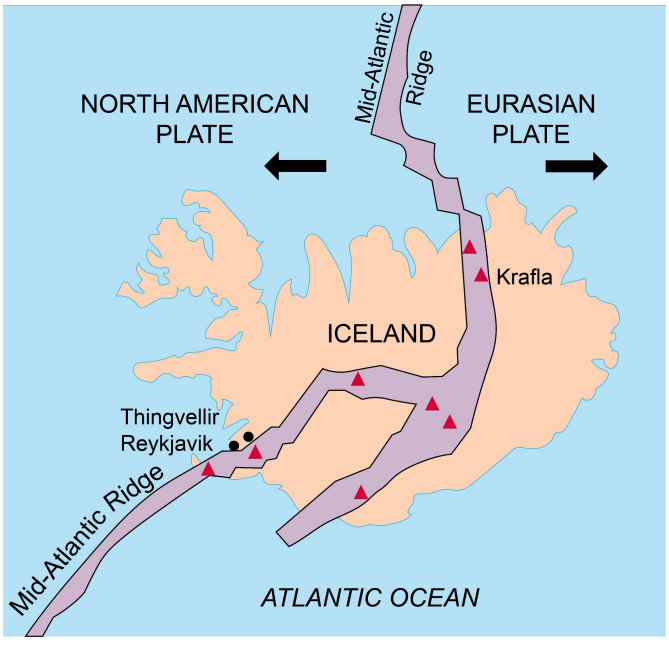
Just below the lithosphere is a shallow layer of mantle called the *asthenosphere*. The partially molten rock in the asthenosphere flows slowly due to a process called convection. Tectonic plates of the lithosphere float on top of the asthenosphere, as they are less dense than the material of the asthenosphere.

Convection is the process by which hot material rises and cooler material sinks. The molten material of the mantle found deep within Earth heats up and begins to rise toward the crust. As the material gets closer to the crust, it cools down in the asthenosphere, the uppermost layer of the mantle. As it cools, it sinks back toward the core. Eventually, the sinking material heats up and rises again. This produces circular movements called *convection currents*. Tectonic plates float on top of the asthenosphere as it flows. The asthenosphere is a part of the mantle that is not in the liquid state. The asthenosphere is solid, but it has plasticity. *Plasticity* is the condition of a solid that allows it to flow like plastic putty.



Red arrows in this diagram represent convection currents.

Look Out!



Tectonic plates interact at plate boundaries.

Tectonic plates are constantly moving. At different times, some plates move faster than others. However, even the fastest plates move only centimeters every year. Tectonic plate boundaries are places where the edges of two or more plates interact. At some boundaries, plates move apart, such as along the mid-ocean ridge that passes through the middle of the Atlantic Ocean and through the middle of Iceland. The North American Plate moves westward, while the Eurasian Plate moves in the opposite direction, splitting that country apart.

As the asthenosphere flows, tectonic plates move with it in different directions. Scientists explain this process through the *theory of plate tectonics*.

Try Now

Making Pangaea

- Label each continent by name.
- Color the fossils or mountains in the legend and color the symbols on each continent in the colors used in the legend.
- Cut out the continents and match up the fossil and mountain evidence to recreate Pangaea.
- Glue the continents into place on your construction paper.