PLATE TECTONICS

The Earth is a dynamic planet. Its interior is actually in motion! The crust on its surface is also in motion. It was not until the 20th century that geologists truly began to understand Earth's dynamic movements. New theories, supported by ever-improving technologies, have made it possible to more clearly understand the forces working within the planet we call home.

The Earth's Interior

Sophisticated machines called **seismographs** are used to understand earthquakes. They measure the strength and arrival times of the different **seismic waves** produced by an earthquake. Careful study of **seismograms** has provided a relatively detailed picture of Earth's interior structure.

The Earth is composed of three different layers: the **core**, the **mantle** and the **crust.** The core is composed of two layers, the solid **inner core** and the liquid **outer core**. The core is the densest layer of the Earth and is composed of nickel and iron. Convection currents in the liquid outer core, combined with the **Coriolis effect** created by Earth's rotation on its axis, are believed to be the source of the Earth's magnetic field.

The **mantle** is composed of the high-density silicate rock, basalt. Basalt is high in iron and magnesium minerals. Due to intense heat and pressure, the mantle is not solid rock, but a highly viscous liquid rock. Detailed studies have shown that the mantle has a strong lower layer called the **mesosphere** and a weaker upper layer called the **asthenosphere**. The mantle is hottest near the core and cools nearer the crust. The hot mantle material rises toward the crust. As it rises it also cools. When it cools, it becomes more dense and then descends back toward the center of the Earth. This circular motion creates convection cells. Convection cells in the mantle cause the crust to move over the Earth's surface.

Earth's outermost layer is the **crust**. There are two different types of crust.

- Basaltic **oceanic crust** pours out from the mantle and is found under the oceans. It is the denser of the two types of crust, but it is also the thinner of the two.
- **Continental crust** is considerably less dense, but it is also considerably thicker than oceanic crust. The crust moves over the Earth's surface in large pieces called **tectonic plates**. Tectonic plates are constructed in layers with crust on the top and a piece of the solid upper mantle below. Geologists call this combination of crust and upper mantle the **lithosphere.**

Lesson Checkpoint:
What are the two layers of the Earth's crust?

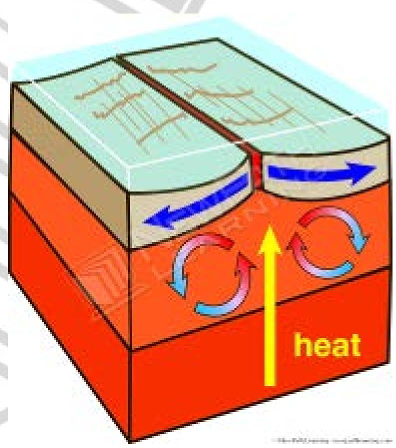
What Is Continental Drift?

In the early 1900's, Alfred Wegener observed that the boundaries of the continents appeared to look roughly like pieces of a large puzzle. Based on this observation, he theorized that the continents were once together and that some force moved them apart. Studies of fossils on different continents and glacial striations in rocks on different continents supported this theory.

Continental drift is the name given to Wegener's theory. According to the continental drift theory, all of the continents were together as a large, single landmass. This landmass was given the name **Pangaea.** About 180 million years ago, the super-continent Pangaea began to split into two smaller continents. Geologists call these two continents **Laurasia** and **Gondwana**. For about 50 years, Alfred Wegener's theory of continental drift was an accepted part of geology. Wegener's theory has been replaced by the more complete theory of **plate tectonics**.

Sea-Floo

In the middle of the Atlantic Ocean is an immense mountain chain. Here **sea-floor spreading** occurs. Geologists have determined that at the **mid-ocean ridge** of the Atlantic Ocean basin, two tectonic plates are pulling away from each other. As they pull away, magma from the Earth's mantle pours out through the crack onto the ocean floor.



Sea-floor spreading is part of the more comprehensive theory called plate tectonics. The mid-ocean ridge, where the oceanic plates spread apart from one another, is where new oceanic crust is formed.

The plates move away from the mid-ocean ridge at a rate of about 1 cm/year.

The Theory of Plate Tectonics

Alfred Wegener's theory of continental drift was convincing; however, he could not explain *how* continental drift occurred. A number of discoveries throughout the 20th century led to a completely new theory, known as **plate tectonics**. This theory was first proposed in the early 1960's.

As explained above, one piece of the theory is sea-floor spreading. This explains how oceanic crust is formed. Geologists explained the presence of deep **ocean trenches** at continent-ocean crust boundaries as the region where oceanic crust goes under the
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One piece of the puzzle, so to speak, that was missing was the mechanism that causes plate tectonics to happen in the first place. Geologists are now in agreement that the driving force for the movement of tectonic plates is convection cells of extremely hot, viscous rock in the mantle. In other words, the rising of hot mantle material and its subsequent descent back to the mantle depths is the engine that drives all the actions and interactions in plate tectonics.