Moving Continents

Imagine an earth that has only one large landmass surrounded by one large ocean. Sounds like something out of a science-fiction novel, but this is what scientists believe the earth once looked like. There were no mountains, faults, or volcanoes, only a flat earth on which animals freely roamed. The processes that formed our geologic features and created the world we know today are part of an unfolding mystery that lays to rest old theories that stated that the earth was stagnant and unchanging. The emerging evidence shows a dynamic earth that is still undergoing geologic changes.

This story begins in the early 1900s with a scientist by the name of Alfred Wegener. Mr. Wegener was a meteorologist, geologist, and Arctic explorer who studied climate patterns. While studying climates, Alfred made some startling observations which led him to theorize that the continents had once been joined together in a super landmass that he named Pangaea, meaning "all earth," and that at some point the continents had broken apart and were still drifting. He supported his theories with several pieces of evidence. He first observed by looking at a map that many of the continents' coastlines seemed to fit together much like a jigsaw puzzle. This is particularly evident with the eastern coastline of South America and and the western coastline of Africa. This observation led Wegener to take a closer look. He began to travel to the different continents and collect rock samples from various mountain ranges. He analyzed the rock samples and discovered that the rock samples from different mountain ranges were not only the same age but were also made of the same materials. He concluded from this investigation that mountain ranges on different continents had once been joined together. Wegener also observed that fossils from the same species of plants and animals were found on different continents. Of particular puzzlement was an ancient fern, which grew only in tropical climates, that was found on the continent of Antarctica. Wegener explained this strange find by hypothesizing that Antarctica had once been located near the equator, where the climate is known to be warm and tropical. From his findings Wegener developed the theory of continental drift, which stated that the continents are drifting and had once been a single landmass. He presented his theory and evidence that supported it to the scientific community in 1912. They scoffed at such an idea because his theory lacked the crucial evidence that explained how the continents could move. Wegener's theory of continental drift would gather dust through several decades until a new discovery would provide the key evidence that Wegener lacked.

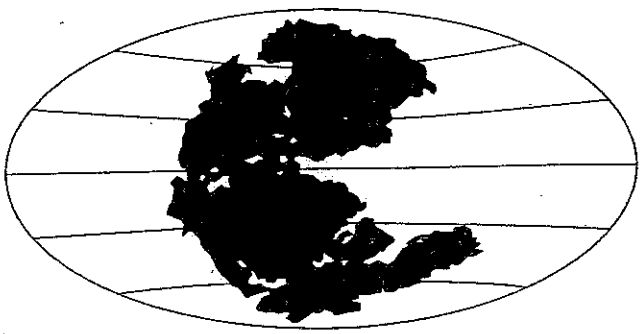
On May 7, 1915 a British passenger ship named the *Lusitania* was sunk. The culprit was a German torpedo. The Germans were waging an underwater battle through the use of a new weapon, the submarine. This new weaponry was proving to be fatal to the Allied forces. An effort to thwart the enemy led to new technology that allowed soldiers to use sound waves to find the German subs that had been so elusive and had cost so many lives. As is often the case, this new technology led to an amazing scientific discovery. There was a crack in the middle of the Atlantic Ocean where molten magma was seen welling up and forming new crust and underwater mountain ranges. Sonar provided a new tool through which scientists could finally map the topography of the ocean floor. Rock samples were taken from this area, and it was discovered that they were much younger than rocks found on the continents. This new discovery left scientists puzzled until the 1960s, when a scientist named Harry Hess proposed the theory of sea-floor spreading. His theory stated that the mid-ocean ridge was a huge crack in the earth's crust where the hot molten mantle was pushed upward, forcing the pieces of crust along the crack to move away from one another, thereby creating new crust and expanding the ocean floor. This left another question to be answered. If the ocean floor was expanding, why wasn't the earth getting larger? Hess explained this by hypothesizing that there were other areas of the earth where crust was being swallowed in a continuous recycling process. Other scientists added evidence to Hess's theory. Wegener's earlier theory of continental drift was reexamined and a new theory was born—the theory of plate tectonics.

The theory of plate tectonics states that the earth is divided into pieces or plates that move as a result of convection in the asthenosphere, which is located directly under the solid crust or lithosphere. The asthenosphere flows with plasticity, meaning that it sometimes behaves as a solid, and it sometimes behaves as a liquid. This theory further states that the plates are moving in different directions at different rates, creating different geologic features.

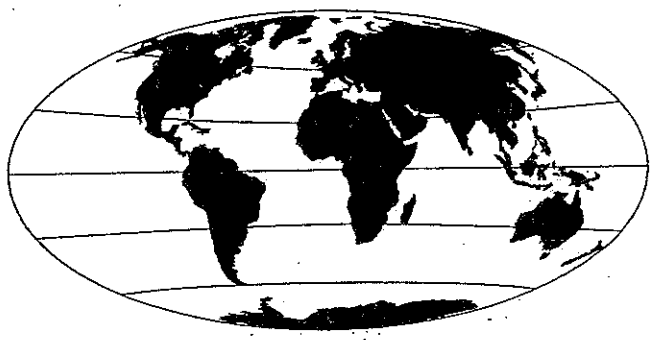
So how do the plates move and what do they create? Imagine a jigsaw puzzle that has been put together. If you try to move those pieces, you would observe that several things might move. In some areas the puzzle would pull apart while in other areas the puzzle would rise up. The same thing happens to the earth's plates along the edges or boundaries where the different plates meet. There are two types of lithospheric plates: continental plates and oceanic plates. Continental plates contain mostly land and are less dense. Oceanic plates contain little or no land and are more dense. The table below identifies the type of plate, type of boundary, type of movement, and the geologic features they create upon the earth's surface.

Type of Plate	Type of Boundary	Type of Movement	Geologic Feature
Oceanic-Oceanic	Divergent	Plates are dividing.	Mid-ocean ridges and new crust
Continental-Continental	Divergent	Plates are dividing.	A rift valley is formed which over time may turn into a sea
Continental or Oceanic	Transform	Plates are sliding past one another.	Cracks in the earth's crust known as faults
Continental-Continental	Convergent	Plates are colliding.	Tall mountain ranges and a joining of continental crust
Continental-Oceanic	Convergent	Plates are colliding, and the less dense continental plate is pushed under the oceanic plate.	Volcanic mountain ranges and a melting of part of the continental plate
Oceanic-Oceanic	Convergent	Plates are colliding, and one is pushed under the other one.	Deep sea trenches and volcanic islands or island arcs

As you can see from the above table, the earth is a dynamic place. It is not stagnant as was once believed. Through observations and improved technology, we now know that the earth's lithosphere, or crust, is divided into plates that are moving because of a convection current in the upper part of the mantle. The interaction between the plates creates many different geologic features that provide evidence that the continents are on the move.



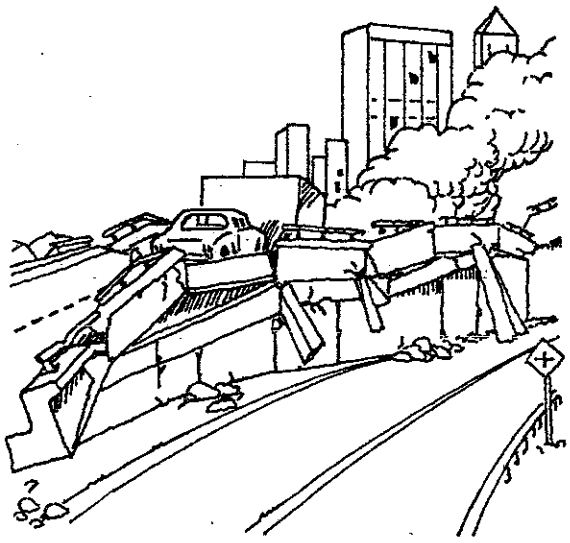
225 Million Years Ago



Present

Name _____

Prelab Questions



1. What was Wegener's theory called?

   _____

2. What did his theory state? _____

   _____

   _____

3. Why wasn't Wegener's theory taken seriously?

   _____

   _____

4. What discovery provided the evidence that Wegener was missing? _____

   _____

   _____

5. What does the theory of plate tectonics state? _____

   _____

   _____

6. How does this theory differ from Wegener's theory? _____

   _____

   _____

7. How is this theory like Wegener's theory? _____

   _____

8. How does technology change our ideas about science? _____

   _____

9. What evidence do we have upon the earth's surface to support the theory of plate tectonics?

   _____

10. Looking at the table, what are the two types of plates that make up our earth's lithosphere?

    _____ and _____

11. Looking at the table, what are the three types of boundaries that can occur between plates?

    _____, _____, and _____

12. Looking at the table, what are the three types of movement that can occur along plate boundaries? _____, _____, and _____