STUDENT GUIDE

Background

Part I: Modeling Plate Movement

Earth's solid lithosphere is fractured into pieces known as tectonic plates. These plates act like separate puzzle pieces, slowly moving in different directions on top of Earth's softer, more plastic asthenosphere. Plate movement is driven by slow churning motions in the hot underlying asthenosphere. As the tectonic plates move and grind against each other, they cause major geologic events, like earthquakes and volcanic eruptions.

There are three main types of motion of the plates. Plates move away from each other (divergent), plates collide together (convergent), and some slide by each other (transform). We use landforms, such as mountain chains and ocean trenches to identify and classify plate boundaries.

At divergent boundaries, where plates move apart and molten rock rises to the surface, ocean basins with mid-ocean ridges (in oceans) or rift valleys (on land) form, looking like large rifts or tears in the crust. Examples include the mid-Atlantic ridge in the Atlantic Ocean and the Great Rift Valley in East Africa.

At convergent boundaries, where plates push together, a variety of landforms can result. If two plates with continental crusts collide, the land compresses like a squeezed sponge, folding rock layers into massive mountains like the Himalayas in Asia, which continues to form as the Indo-Australian and Eurasian plates collide. If two oceanic crusts collide, one slides over the other, forcing the sinking plate downward into the asthenosphere until it melts. This motion, called subduction, can also be found where a continental crust collides with an oceanic crust. The denser oceanic crust subducts beneath the continental crust, forming a deep sea floor trench at the continental edge. An example is the Andes Mountains, a volcanic mountain chain, which formed as the Pacific plate collides and sinks beneath the South American plate.

At transform boundaries, plates slide or scrape past each other. Built up tension between these plates is released causing faulting and earthquakes like those experienced in California along the San Andreas Fault. The entire edge of the Pacific plate has so many earthquakes and volcanoes caused by subduction zones and transform faults that the region is called the "Ring of Fire."

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Part II: Alfred Wegener and the Theory of Continental Drift

Alfred Wegener was the first person to use evidence to support the idea of the movement of Earth's plates. His idea, known as the Theory of Continental Drift, was based upon the following things: fossil evidence from plants and animals, the shapes of the continents, and the landform features that matched when the continents were put together. Wegener's theory was not accepted during his lifetime. However, his ideas were the first stepping-stones to the current theory of plate tectonics.

Part III: Ancient Earth

We have learned that plates are in motion even though, in most cases, it takes millions of years for results to become apparent. Mountains, volcanoes, new crust material, and earthquakes are some of the geologic events that occur on and change Earth's surface as a result of plate movement. But, Earth holds another surprise. The location and appearance of the landmasses of Earth have changed as a result of plate movement, too! Scientists believe that all of Earth's landmasses were connected in one "super continent" about 225 million years ago. The landmasses moved apart and formed the continents we see today. In fact, landmasses are still moving as they are carried by the lithospheric plates. In March of 2011, parts of the coast of Japan were moved as much as eight feet by an earthquake.

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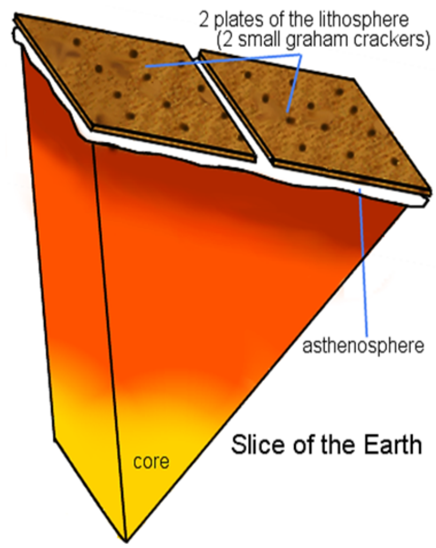
Part I: Modeling Plate Movement



1. Spread a heaping tablespoon of marshmallow fluff on the large cracker piece.

2. Cover the fluff with the two smaller cracker pieces.

3. The two small cracker pieces represent lithospheric plates of Earth. The marshmallow fluff represents the asthenosphere layer of Earth.

4. Refer to the **Slice of Earth** diagram. Use it to label the cross-section diagram of the model in the first box of Part I in your Student Journal. Don't label the large cracker piece on the bottom.

5. Think about the cars that side-swiped each other. Slide one cracker one direction and the other cracker in the opposite direction (↑ ↓). What do you feel as the sides of the crackers rub against each other as they slide over the fluff?

6. Find the box in your Student Journal labeled Figure ONE. Draw arrows to show the direction of movement on your model. A diagram has been started for you. Add details as instructed.

7. Think about the cars converging! Move the two small graham crackers toward each other such that they form a small upside down "V" on top of the marshmallow fluff.

8. Find the box in the Student Journal labeled Figure TWO. Draw a cross-section diagram of your model as it looks now. Draw arrows to show the direction of cracker movement. Label and answer the questions about Figure TWO.

9. Think about the cars diverging! Move the two small crackers away from each other so that they are slightly separated on the marshmallow fluff. Find the box in the Student Journal labeled Figure THREE. Draw a cross-section diagram of your model as it looks now. Draw arrows to show the direction of cracker movement. Label and answer the questions about Figure THREE.

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10. Back to converging! Move your two small graham crackers toward each other again. This time, push one graham cracker a little under the other graham cracker when they meet, so that one slightly overlaps the other. Find Figure FOUR in your Student Journal. Draw a cross-section diagram of your model as it looks now. Draw arrows to show the direction of cracker movement. Label and answer the questions about Figure FOUR.

Part II: Alfred Wegener and the Theory of Continental Drift

You will take the teacher print out of the individual continents and cut them out and place them in the globe on your Student Journal page. Paste the landmasses together and use the legend to match up the fossils, fossil evidence of climate change, and the shapes of landmasses.

Part III: Ancient Earth

Paste or tape the maps of Earth as it changed through ancient history in the chart on your Student Journal page. Then draw in your prediction of what the landmasses will look like 200 million years from today in the last box.