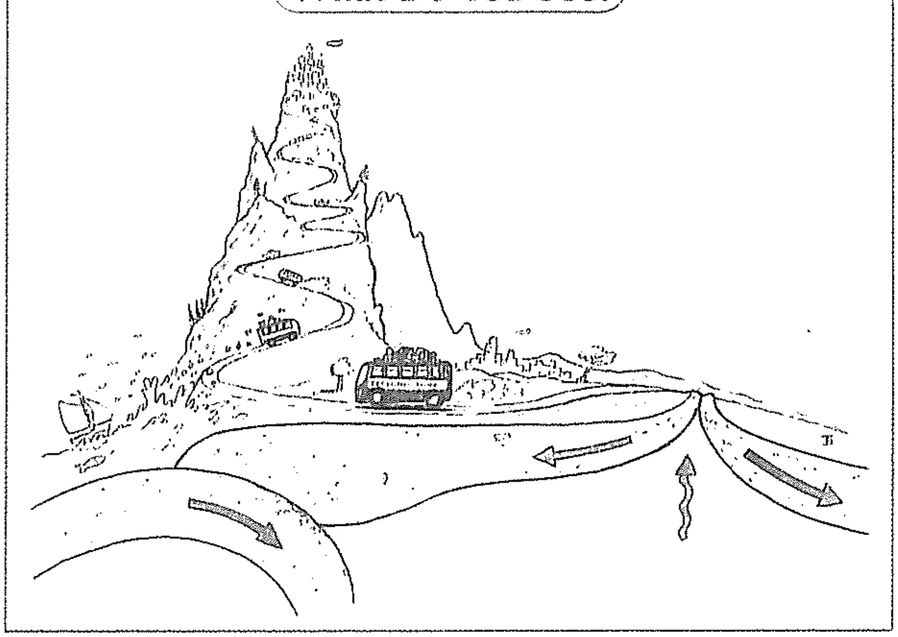
Section 4 Plate Motions and Plate Interactions

What Do You See?



g Outcomes

s section, you will

a model of a plate ... another plate

cribe several ... plate motion

sify and label ... vement at plate ... a world map that ... tive plate ...

ntify the ... ns of the world ... te motions

cribe the ... ting of your ...

Think About It

Earth's crust is constantly being formed in some places and destroyed in others. Suppose you could take a ride on a lithospheric plate that was moving at a fast rate.

- **Where do you think you would find the most "action" on Earth in regard to crust formation? Why?**
- **Where would be logical places to look for crust being destroyed? Why do you think that?**

Record your ideas about these questions in your *Geo* log. Include sketches as necessary. Be prepared to discuss your responses with your small group and the class.

Investigate

In this *Investigate*, you will simulate (run a model that shows) what happens when one plate moves beneath another. You will also model what happens when plates move apart from one another at a spreading ridge. Finally, you will investigate different types of plate boundaries, including the one closest to your community.

Part A: Forces Causing One Lithospheric Plate to Move Beneath Another (Subduction)

1. Partly fill a large, rectangular tub with warm water. Wait until any tiny air bubbles have disappeared. The water has to be perfectly clear.

2. Very slowly and carefully, put a few ounces of liquid dish detergent in the water and mix it slowly and carefully with a mixing spoon. If any soap bubbles remain on the water surface, scrape them off with a damp sponge.

3. Cut a piece of vinyl plastic to be about 15 cm wide and about 30 cm long. Trim a flat, clear plastic ruler with scissors to be the same width as the plastic sheet. (The ruler should sink in water.) Tape the ruler to one end of the plastic sheet.

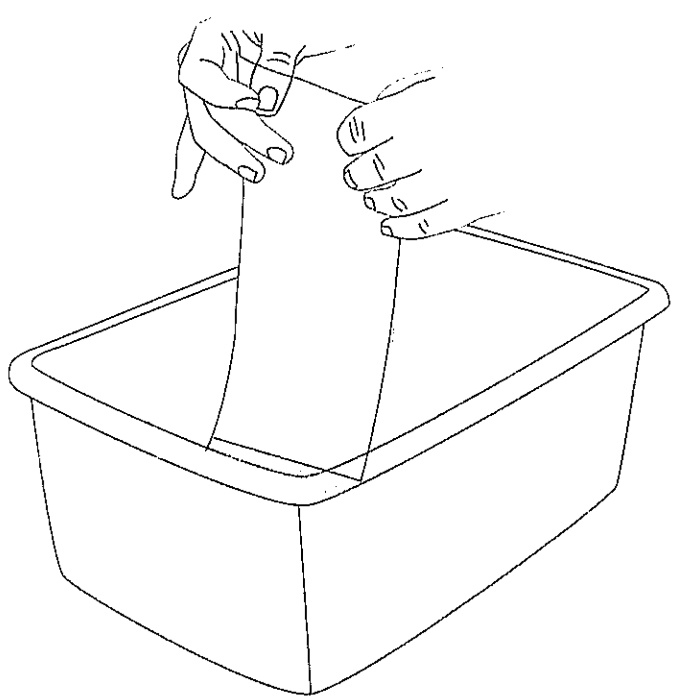
4. Dip the ruler end of the plastic sheet into the water to a depth of about 1 cm. Immediately place the plastic sheet on the water surface. Do this by holding the ends up and letting the sagging middle part of the sheet touch the water surface first, to avoid trapping air bubbles under the sheet. Observe what happens. Repeat this step as many times as you need to make careful observations.

   a) Record your observations. Include a description of the motion of the plastic sheet in the water.

   b) What is the force that makes the plastic behave as it did?

   c) How does this demonstration show what happens in a place where one plate moves beneath another plate (*subduction* zone)?

Keep your work area clean and dry. Have paper towels ready for the wet plastic that is taken out of the tub.



Part B: Modeling Plate Motions and Plate Interactions

1. Obtain the equipment shown in the diagram below.

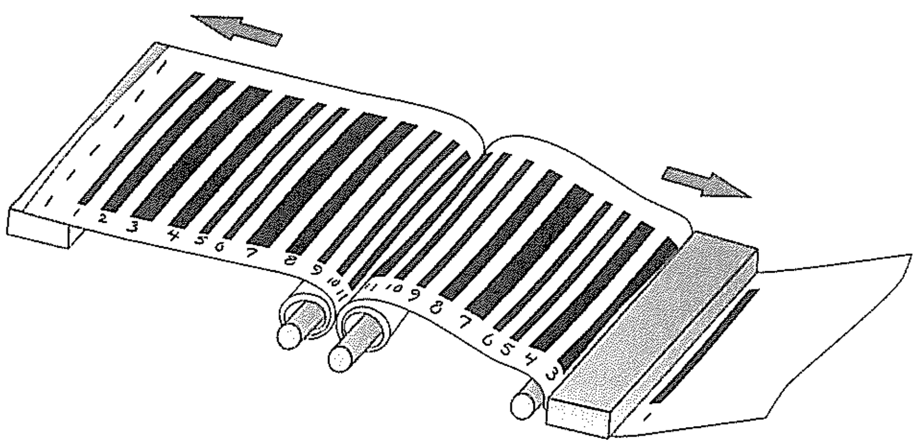
2. Use the equipment to model a steady seafloor spreading and subduction, as follows. One student holds the two rolled-up dowels in one place, loosely, so that they can turn but not shift their position. Another student holds the stapled piece of 1″ × 2″ lumber "continent" and pulls it away from the rolled-up dowels. A third student holds the dowel and piece of 1″ × 2″ lumber "subduction zone" at the other end loosely in place. A fourth student pulls the paper strip from under the piece of 1″ × 2″ lumber "subduction zone." Be sure to unroll the paper strips at the same rate, so that the numbers of the stripes stay matched up as they appear.

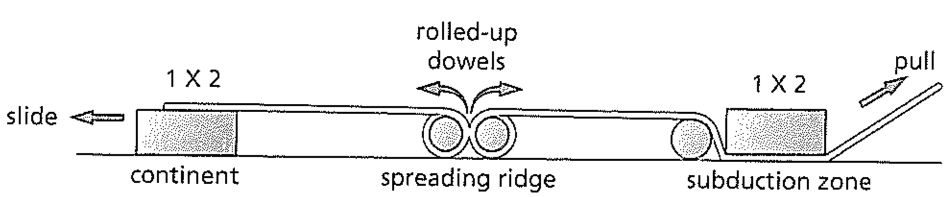
   a) What do the rolled paper strips on the dowels represent?

   b) What does the section of paper between the dowels and the continental lithosphere (the piece of 1″ × 2″ lumber) represent?

   c) What happens to the length of this section of paper as the dowels are unrolled?

   d) As the dowels are unrolled, what happens to the width of the section of paper between the dowels and the subduction zone (the other piece of 1″ × 2″ lumber)?





3. Use the equipment to model a collision of a spreading ridge and a subduction zone, as follows: Begin with the materials arranged in the same way as at the end of *Step 1*. While two students pull the paper strips to unwind the two rolled-up dowels, the student holding those dowels slides them slowly toward the subduction zone. The student operating the subduction zone needs to make sure that the stripes appearing at the spreading ridge continue to have their numbers matched up.

   a) What happens to the length of the strip of paper between the dowels and the "continent" side in this situation?

   b) What happens to the length of the strip of paper between the dowels and the "subduction zone"?

   c) At what "place" does the spreading ridge eventually arrive?

4. Think about the following questions and write a brief answer to each in your *Geo* log.

   a) In the first part of the modeling (*Step* 2), how long will the ocean on the "subduction" side last?

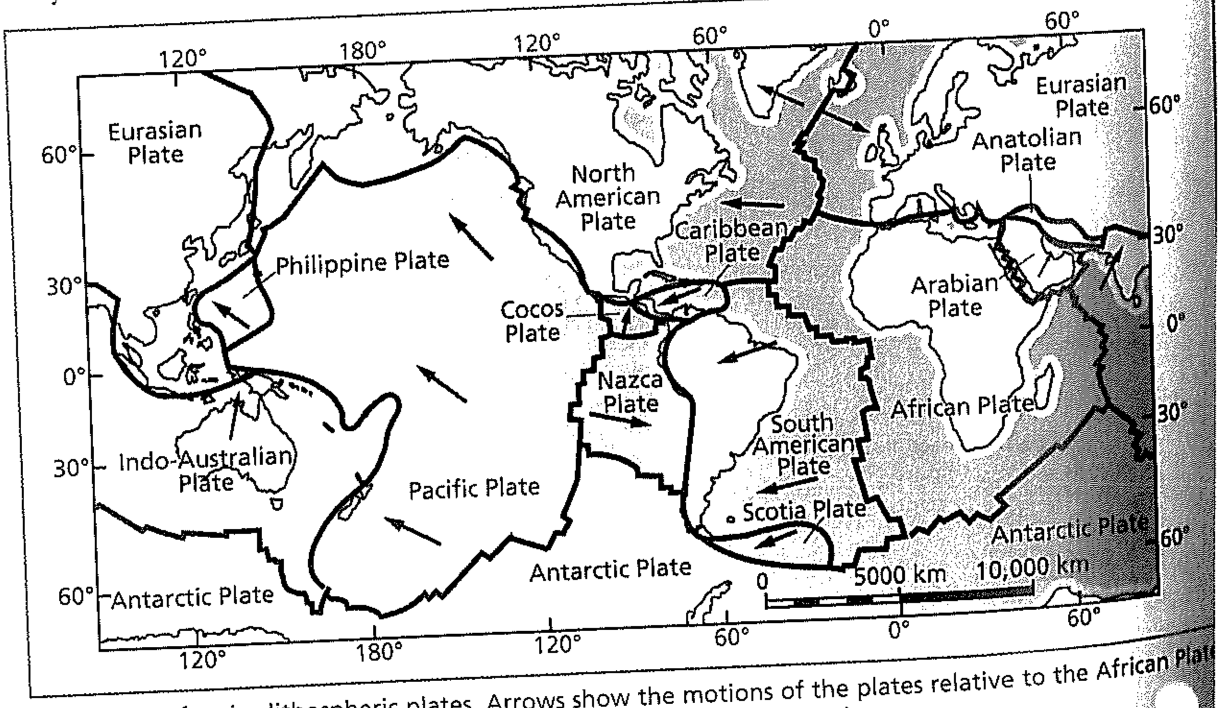
   b) In the second part of the modeling (*Step 3*), what do you think would happen in real life when the spreading ridge arrives at the subduction zone?

   c) In the second part of the modeling (*Step 3*), how would the ocean on the "continent" side change after the spreading ridge arrives at the subduction zone?

   d) In both cases, what do you think would actually happen to Earth's crust if a continent became blocked in its movement away from the spreading ridge by something happening on the other side of the continent?

Part C: Plate Boundaries on World Maps

1. Look at the following world map that shows the relative motion of the plates. Observe what it shows about how plates move relative to each other.



World map of major lithospheric plates. Arrows show the motions of the plates relative to the African Plate which happens to be moving most slowly relative to Earth's axis of rotation.

a) Name two plates that are moving toward each other (converging or colliding).

b) Name two plates that are moving apart (diverging or spreading).

c) Name two plates that are sliding past each other (transform).

2. Use a blank world map to make a map that shows the three major types of plate boundaries.

a) On the map, color the boundary lines that separate two converging plates (where plates are moving toward each other). Do not outline both of the plates completely. Highlight only the boundary between the two plates.

b) Using two other colors, highlight the divergent plate boundaries (where plates are moving away from one another) and the transform boundaries (where plates slide past one another). Make a key that shows this color code.

Part D: The Plate Tectonic Setting of Your Community

1. Describe the plate tectonic setting of your community. Refer to your world map and the *This Dynamic Planet* map (USGS) in your description.

a) How far is your community from the nearest plate boundary?

b) What type of plate boundary is it?

c) How might your community change its position relative to plate boundaries in the future?

Digging Deeper

THE MOTION OF LITHOSPHERIC PLATES

Types of Plate Boundaries

Plate boundaries are active. Therefore, they are interesting areas for geologists to study. In the *Investigate*, you ran a model that showed what happens when one plate moves beneath another. This process is called **subduction.** You also modeled what happens when plates move apart from one another. This occurs at a spreading ridge. You also investigated different types of plate boundaries. Geologists use three descriptive terms to classify the boundaries between plates. You read about them in *Section 1.* At divergent plate boundaries two plates move away from each other. At convergent plate boundaries two plates move toward each other. At transform plate boundaries two plates slide parallel to each other.

Seafloor Spreading and Divergent Plate Boundaries

You have already read some things about divergent plate boundaries. You learned that mid-ocean ridges are divergent plate boundaries. The mid-ocean ridges are places where mantle asthenosphere rises slowly upward. As it rises, some of the rock melts to form magma. Why does melting happen there? To understand that, you need to know that the melting temperature of rock decreases as the pressure on the rock decreases. As the mantle rock rises, its temperature stays about the same because cooling takes a long time. However, the pressure from the overlying rock is less so some of the rock melts. The magma then rises up because

Geo Words

subduction: the process of one lithospheric plate moving beneath another.