Seafloor Spreading: Divergent Plate Boundaries

A Carolina Essentials™ Activity

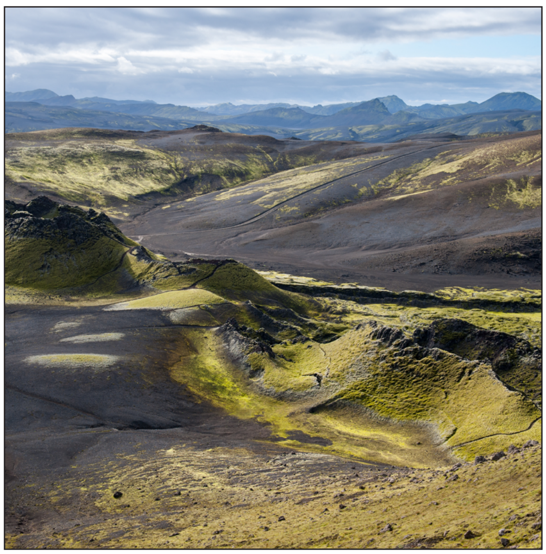
Overview

This modeling activity illustrates the surface and internal processes occurring at divergent plate boundaries. Students use the model to explain surface and ocean floor features at the Mid-Atlantic Ridge and extend the model to explain surface features of the Great Rift Valley. The activity may be completed by small groups of students, pairs of students, or individually. The required materials allow for the activity to be completed at home.

Earth and Space Science
Grades: 9–12

Phenomenon

What internal and surface geologic processes are at work here?



Laki craters, Iceland

Thingvellir National Park, Iceland

Essential Question

How do surface features provide evidence of Earth's internal processes?

Activity Objectives

1. Construct a model of seafloor spreading.
2. Explain surface features in Iceland based on your seafloor spreading model.

TIME REQUIREMENTS

PREP	ACTIVITY
15–20 min	40–50 min

Teacher Prep: 15–20 minutes
Student Activity: 40–50 minutes

SAFETY REQUIREMENTS

No PPE required is required for the activity. Remind students of proper scissor use.

MATERIALS

Sheet of card stock

Tissue paper

White printer paper

Ruler

Scissors

Transparent tape

2 pens, pencils, or markers (different colors)

HELPFUL LINKS

Tectonic Sandbox

Carolina® Modeling Tectonic Plate Boundaries Kit

Pangaea Puzzle Kit

REFERENCE KITS

Modeling Earth Processes: Destructive Forces

Plate Tectonics and Island Formation

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Next Generation Science Standards* (NGSS)

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	**ESS2.A: Earth Materials and Systems** • Earth's systems, being dynamic and interacting, causes feedback effects that can increase or decrease the original changes. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** • Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean floor features and for the distribution of most rocks and minerals within Earth's crust.	**Stability and Change** • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Teacher Preparation and Disposal

Copy or upload the student activity sheets. If time is a concern, you may wish to pre-cut the tissue paper, printer paper strips, and card stock. Models can be saved for additional classes or the materials can be recycled.

Student Procedure

1. Fold the printer paper in half lengthwise, twice. Unfold the paper and cut along the crease lines making 4 strips (11 inches). Tape the 4 strips together to make a 44-inch strip.
2. Cut out a 4-inch square of tissue paper. In the center of the square, cut a slit the exact width of the strip of paper. Mark the ends of the slit with a 1/2-inch line (see Figure 1).
3. Cut a 3-inch square from the center of the card stock (see Figure 2).

Figure 1.

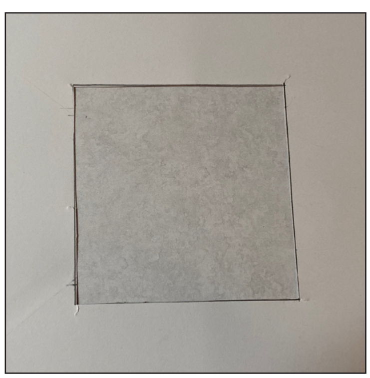

Figure 2.

Teacher Preparation and Tips

To save class time, pre-cut the paper items.

The slit in the tissue paper must provide a tight fit. The tissue should tear at both ends as the paper strip is pulled through, indicating an elongation of the fissure.

In lieu of sketching the model, students can take and upload pictures, then label the pictures.

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Student Procedure continued

4. Securely tape the tissue paper over the square in the card stock (see Figure 3).
5. Fold the 44-inch strip of printer paper in half to make a 22-inch strip. Do not crease the paper.
6. Insert the ends of the printer paper into the tissue paper slit until 1 inch of paper is above the slit. Hold the card stock up so the paper strip hangs freely (see Figure 4). Sketch the model and label what each piece represents.
7. Slide the paper strip up 3 inches. Gently separate the strip into 2 pieces. Color the inside faces of the strips the same color.
8. Push the paper strip up an additional 3 inches. Select a second color and color the uncolored sections of the inside faces of the strips. Sketch and label the model.
9. Repeat steps 7 and 8 until the paper strip has been pulled through the slit in the tissue paper. Sketch the final model, paying close attention to any changes in the tissue paper.

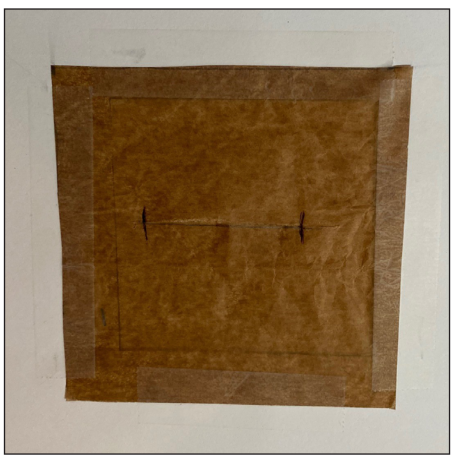

Figure 3.

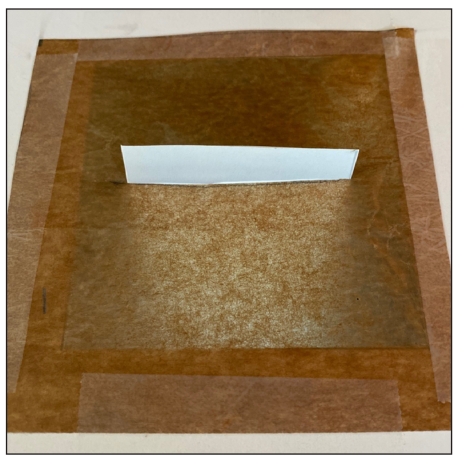

Figure 4.

Teacher Preparation and Tips

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Data and Observations

Model Development

Initial Model: Sketch and Label

This step models the initial upwelling of magma through a section of the Earth's crust that is thin and weak.

Intermediate Model: Sketch and Label

The strip of paper now represents lava flow from the fissure outward. Old lava is being pushed away from the fissure as new eruptions take place.

Final Model: Sketch and Label

In the final model, the paper strip should extend past the edges of the card stock base. This shows a complete cycle of magma upwelling and seafloor spreading at a divergent plate boundary and eventual recycling of rock with the return to magma at a convergent boundary. A convection current on both sides of the fissure is represented.

Analysis

1. What does each type of paper represent in the model?

   Printer paper strip = magma; card stock = crustal rock; tissue paper = thin, brittle crustal rock

2. The colored bands represent the Earth's changes in magnetic field strength. How can this information be used as evidence for convection currents in the mantle?

   When the magnetic bands match on opposite sides of a fissure, it indicates the magma was from the same source but was pushed away from the fissure on both sides. The movement away from the fissure is an indication of a convection current.

3. Use the model you constructed for the Mid-Atlantic Ridge and apply it to explain differences and similarities between the rift valleys in Iceland and East Africa.

Thingvellir National Park, Iceland

Great Rift Valley, Kenya

Both valleys are long and bounded by mountains on both sides. The valley floors are relatively flat with some evidence of lava flows. The Iceland rift valley must be younger as it is not as wide, and the rock cliffs do not show signs of much erosion. The valley walls are steep and jagged. The Great Rift Valley in Africa is much wider. The mountainsides are smoother and vegetated, indicating the valley is older but has the same geologic origins as the Iceland rift valley. Both features are evidence of a divergent plate boundary.

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