Grade Six: Plate Tectonics

Sea Floor Spread

Lesson Concept

Sea floor spread discovered at mid-ocean ridges provided evidence of the spread of newer molten rock. This is the final piece of evidence to explain what is now the guiding theory of earth sciences: Plate Tectonics.

Link

Plotting earthquakes is not the only evidence of plate tectonics. The discovery of mid-ocean ridges provided evidence to explain movement of new molten material.

Time

50 minutes (Plus a suggested homework assignment)

Materials

Whole class

- World Map which includes Mid-Ocean Ridges (can use USGS Dynamic Planet map)
- Tanya Atwater “Sea Floor Spread” animations

Per Group (table group)

- Stapler

Individual

- 9"x12" construction paper (light color) (H2-example of ocean floor)
- Copy of spreading pattern (H3)
- Scissors
- “Sea Floor Spread” Rubric (see separate document in folder)

Advance Preparation

- H3 a&b Read through teacher directions for “Modeling Sea-Floor Spreading”
- Make a model for yourself
- Xerox copies of Spreading pattern for each student (H2)
- Xerox copy of “Sea Floor Spread” rubric (H1)
- Cut 9"x12" construction paper for each student
• Download Tanya Atwater’s Sea Floor Spread animations from SBCEO Portal, California Streaming
• Obtain world map which includes Mid-Ocean Ridges

Procedure:

Engage (5 minutes) **Sea-floor spreading at the Mid-Ocean Ridge continuously adds new material to the ocean floor**

1. Show world map that includes Mid-Atlantic Ridge to students. Ask students to think-pair-share what the squiggly line represents that is between continents in the oceans.

Explore/Explain (5 minutes) **Sea-floor spreading at the Mid-Ocean Ridge continuously adds new material to the ocean floor.**

2. Show Tanya Atwater animations of Sea Floor Spreading.
3. Show animation several times to increase understanding while discussing movement of ocean floor, what happens as it nears continents, etc.

Explore (20 minutes) **Sea-floor spreading at the Mid-Ocean Ridge continuously adds new material to the ocean floor.**

Teacher Note: Adapt the directions to use the stripe pattern. Do not have students draw the strips.

4. Ask students to make the model according to attached directions. Label construction paper to make meaning of the model:
   a. Outside Slits: Subduction zones of Deep Ocean Trenches - older, cooler, more dense rock.
   b. Middle Slit: Mid-Ocean Ridge/Central Valley – young, hot, less dense rock.
5. Ask students to fold and cut striped spreading pattern vertically and staple together. Complete the model following directions.
6. Ask partners to practice working the model several times.
**Explain**  
*(10 minutes)* Magnetic stripes show that material has moved away from the ridge over time.

   a. What feature of the ocean floor does the center slit represent?  
   b. What do the slide slits represent?  
   c. What does the space under the paper represent?  
   d. As shown by your model, how does the ocean floor close to the center slit differ from the ocean floor near a side slit? How does this difference affect the depth of the ocean?

**Evaluate**  
*(homework)*

8. Students write a paragraph explaining the science behind Sea Floor Spreading using the following words:  
   a. mid-ocean ridge  
   b. spreading  
   c. subduction  
   d. denser rock  
   e. molten material

9. Share their model and explanation with their parents.
6.6 Plate Tectonics:
- Sea Floor Spread

Science Matters

- Deep ocean trench
  - Europe
  - Subduction
- Mid-Ocean Ridge
  - Young, hot, less dense rock
- Central Valley
  - Young, hot, less dense rock
- Deep ocean trench
  - North America
  - Subduction
Plate Tectonics: Sea Floor Spread
Students conduct an investigation to model sea-floor spreading at mid-ocean ridges.

**Prepare for Inquiry**

**Key Concept**
Sea-floor spreading at the mid-ocean ridge continuously adds new material to the ocean floor.

**Skills Objectives**
After this lab, students will be able to
- make a model of sea-floor spreading

**Prep Time** 15 minutes

**Class Time** 30 minutes

**Advance Planning**
Gather all of the materials at least one day before the activity. Prepare two sample sheets: a sheet with stripes predrawn, and a sheet folded and marked for cutting.

**Alternative Materials**
Instead of having small groups making several models, you could divide the class into larger groups and have each group use butcher paper to make a large model.

**Safety**
Students should exercise caution when cutting paper with scissors. Review Safety Guidelines in Appendix A.

**Teaching Resources**
- Laboratory Manual
  - Modeling Sea-Floor Spreading Student Worksheets

**Guide Inquiry**

**Invitation**
Help students focus on the key concept by asking: What happens at the mid-ocean ridge? (Molten material rises from the mantle and erupts.) What forms when the molten material hardens? (New ocean floor) What happens to the new ocean floor? (It moves outward on both sides of the ridge.) How are magnetic stripes evidence of this process? (The magnetic stripes show that material has moved away from the ridge over time.) What happens at deep-ocean trenches? (Oceanic crust sinks back into the mantle.)

**Introduce the Procedure**
Have students read through the entire activity. Then ask: What is the purpose of this activity? (To make a model of sea-floor spreading) Why do you cut the first sheet in half? (The sea floor spreads in both directions from the mid-ocean ridge. Cutting the sheet in half allows the model to represent movement on both sides of the ridge.) After you've cut the sheet in half, how does the pattern of stripes on one half compare with the pattern on the other half? (The pattern is the same on both halves.)

**Troubleshooting the Experiment**
Demonstrate how to begin to make each of the two sheets. Then show students your samples of the finished products. Allow them to refer to these sheets as they make their own. Ensure that students make the slits large enough to pull the paper through easily. They should cut a little more than halfway through the width of the sheet.
6. Put the two striped strips of paper together so their Start labels touch one another. Insert the Start ends of the strips up through the center slit and then pull them toward the side slits.

7. Insert the ends of the strips into the side slits. Pull the ends of the strips and watch what happens at the center slit.

8. Practice pulling the strips until you can make the two strips come up through the center and go down through the sides at the same time.

**Analyze and Conclude**

1. **Making Models** What feature of the ocean floor does the center slit stand for? What prominent feature of the ocean floor is missing from the model along the center slit?

2. **Making Models** What do the side slits stand for? What does the space under the paper stand for?

3. **Comparing and Contrasting** As shown by your model, how does the ocean floor close to the center slit differ from the ocean floor near a side slit? How does this difference affect the depth of the ocean?

4. **Making Models** What do the stripes on the strips stand for? Why is it important that your model have an identical pattern of stripes on both sides of the center slit?

5. **Applying Concepts** Explain how differences in density and temperature provide some of the force needed to cause sea-floor spreading and subduction.

6. **Communicating** Use your own words to describe the process of sea-floor spreading. What parts of the process were not shown by your model?

**Expected Outcome**

Students will build a model that shows the formation of new sea floor at a mid-ocean ridge, the spreading of the sea floor on both sides of the ridge, and the subduction of the sea floor at deep-ocean trenches.

**Analyze and Conclude**

1. The center slit represents the central valley of the mid-ocean ridge. The missing feature is the mountainous ridge.

2. The side slits represent deep-ocean trenches. The space beneath the paper stands for the asthenosphere.

3. The ocean floor as shown by the strip near the center slit is younger, hotter, and less dense than the ocean floor farther away. As the floor moves away from the ridge, it cools and becomes denser. The ocean floor as shown by the part near a side slit is older, cooler, and denser. The increased density causes the depth of the ocean to increase.

4. The stripes represent the magnetic stripes in the rock of the ocean floor. The pattern of magnetic stripes is the same on both sides of the mid-ocean ridge.

5. Temperature differences cause convection currents. These currents cause molten rock to erupt through the valley along the center of the mid-ocean ridge. As material erupts, the sea floor spreads, cools, and becomes denser. The denser material sinks back into the mantle when it reaches a trench.

6. Answers will vary. A typical answer should mention the eruption of molten material at the mid-ocean ridge, the spreading of the sea floor, and the subduction of oceanic crust at deep-ocean trenches. Parts of the process not shown by the model include changes in density and the melting that occurs at subduction zones.

**Extend Inquiry**

**More to Explore** Answers will vary. A typical answer might suggest drawing an island near the Start label on one of the strips. Then, through the movement of the strip through the model, the island's position would change. It would sink below sea level and eventually be subducted.