EARTH SCIENCE FAX!
P.O. Box 219 • Batavia, IL 60510
(800) 452-1261 • Fax (866) 452-1436
www.flinnsci.com • E-mail: flinn@flinnsci.com

FLINN SCIENTIFIC, INC
"Your Safer Source for Science Supplies"
Catalog No. AP7171
Publication No. 7171

Sea Floor Spreading Student Activity Kit

Introduction

Observe the amazing consequences of sea floor spreading and continental drift over geological time using the following hands-on activities.

Concepts

- Sea floor spreading
- Continental drift
- Pangaea
- Plate tectonics

Background

Pangaea, Greek for "all Earth," is the name given to the supercontinent that existed during the Paleozoic and Mesozoic eras about 250 million years ago (see Figure 1). The term Pangaea was first coined by the German meteorologist Alfred Wegener (1880–1930) in the early 1900s when he observed that the margins of the current continents looked like pieces of a giant puzzle. Wegener hypothesized that the land masses that composed Pangaea must have broken off and drifted away from one another over time. He called this process *continental drift.* Wegener's ideas about continental drift were very controversial and not accepted until well after his death in the 1930s.

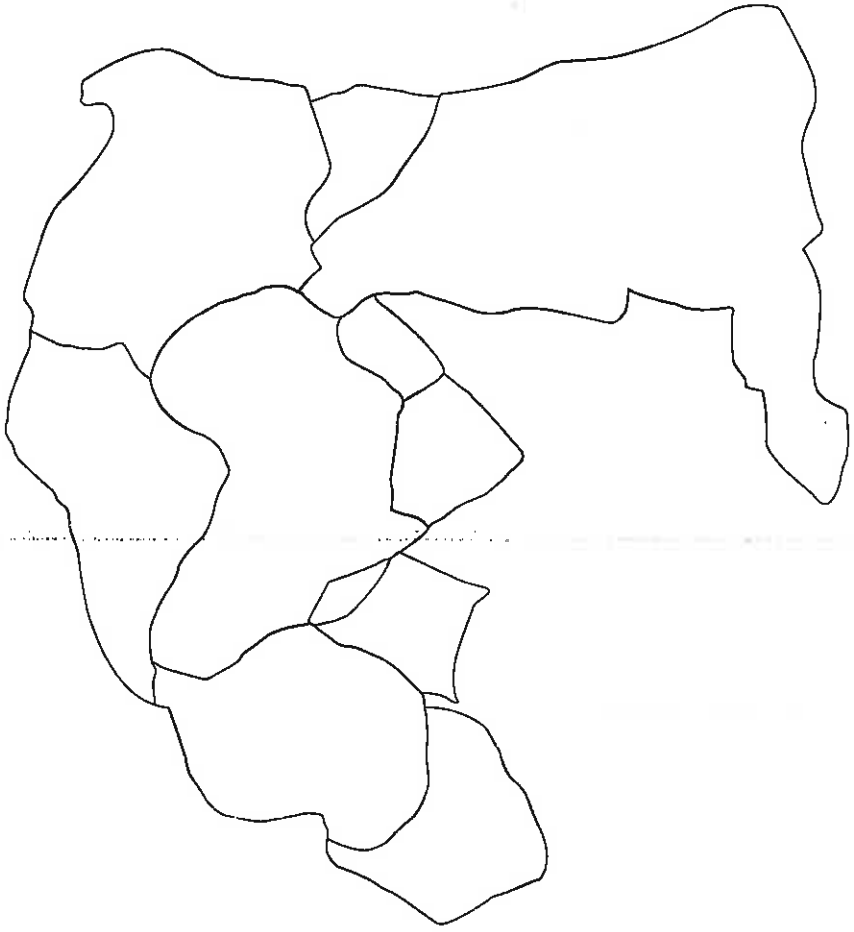

Figure 1. Pangaea

There are three main types of evidence, besides the apparent puzzle-like fit of the continents, that support the theory of continental drift—fossil evidence, climate evidence, and rock evidence. Fossils of the reptile *Mesosaurus* have been found in both Africa and South America. This swimming reptile lived on land in freshwater. It is very unlikely that it could have swum between the two continents. *Mesosaurus* must have lived on both continents when they were combined. Another fossil that supports continental drift is the plant *Glossopteris.* This fossil fern has been found in Australia, Antarctica, Africa, India, and South America. Finding this fossil in such different climates implies that all of these areas were once connected and had similar climates. Similar rock structures and types of rocks have also been found on different continents, lending to further support to continental drift.

In the 1940s and early 1950s scientists began to use sound waves to map large areas of the Earth's ocean floors. It was found that the ocean floors were very complex and had mountains and valleys similar to the continents above water. A series of ridges

Name: _____

extending through the center of the Atlantic, Pacific and other oceans were also discovered. These underwater, mountain-like ridges stretch along the center of most of the Earth's ocean floor. How were these ridges formed? In the early 1960's Princeton scientist Harry Hess proposed the theory of sea floor spreading. *Sea floor spreading* occurs when the molten material in the mantle rises to the surface of the mid-ocean ridges. The molten material then flows sideways, carrying the sea floor away from the ridge in both directions (see Figure 2). As the sea floor spreads apart the molten magma moves upwards and creates new sea floor as it cools. As this new cooling sea floor contracts and becomes denser it sinks and forms a ridge.

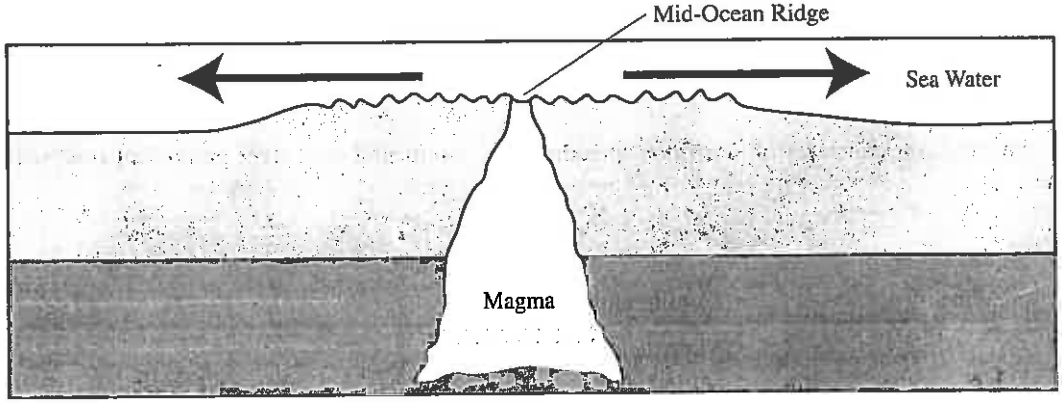

Figure 2. Sea Floor Spreading

With the discovery of continental drift and sea floor spreading, scientists began to understand how the sections of sea floor and continents moved in relation to one another. In the late 1960s, a new theory was formed called *plate tectonics*. According to this theory, the Earth's crust and part of the upper mantle are broken into sections called plates. These plates move around on the mantle just like rafts float on water. The plates can move toward each other and collide, they can pull apart, or they can simply slide past one another. When the plates interact with one another the results of their movement can be seen at the plate boundaries. At these plate boundaries, mountains may form, volcanoes may form and erupt, or earthquakes may occur.

Activity Overview

In the following activities you will simulate the movement of the continents and sea floor over geological time and observe evidence of continental drift.

Materials

- Ocean Base, blue, laminated
- Pangaea Continental Plates Worksheet, green, laminated
- Ocean Crust Worksheet, yellow, laminated
- Ocean Crust Worksheet, red, laminated
- Ocean Crust Worksheet, purple, laminated
- Marker, dry-erase
- Paper towels
- Scissors

Safety Precautions

This activity is considered nonhazardous. Follow all normal classroom guidelines.

Procedure

Part I. The Current Ocean Floor

1. Obtain the green Pangaea Continental Plate Worksheet and a pair of scissors.
2. Cut out all of the continental plates on the worksheet along the dotted lines.
3. Note that the continental plate cutouts show the smooth edges of the continental plates and not the current day coastlines.

Name: _____

4. The continental plates are numbered as follows:
   1. North America
   2. Greenland
   3. Eurasia
   4. South America
   5. Africa
   6. Adriatic Promontory
   7. Arabia
   8. Antarctica
   9. Madagascar
   10. India
   11. Australia

5. Obtain the yellow, red, and purple Ocean Crust Worksheets. Use scissors to cut out all of the ocean crust pieces on this worksheet.

6. Obtain the blue ocean base.

7. Assemble all of the Pangaea Continental and Ocean Crust pieces on the blue ocean base as shown in Figure 3. G = Green, P = Purple, R = Red, Y = Yellow. Note that not all of the pieces are interlocking. This is a representation of the Earth's current ocean floor.

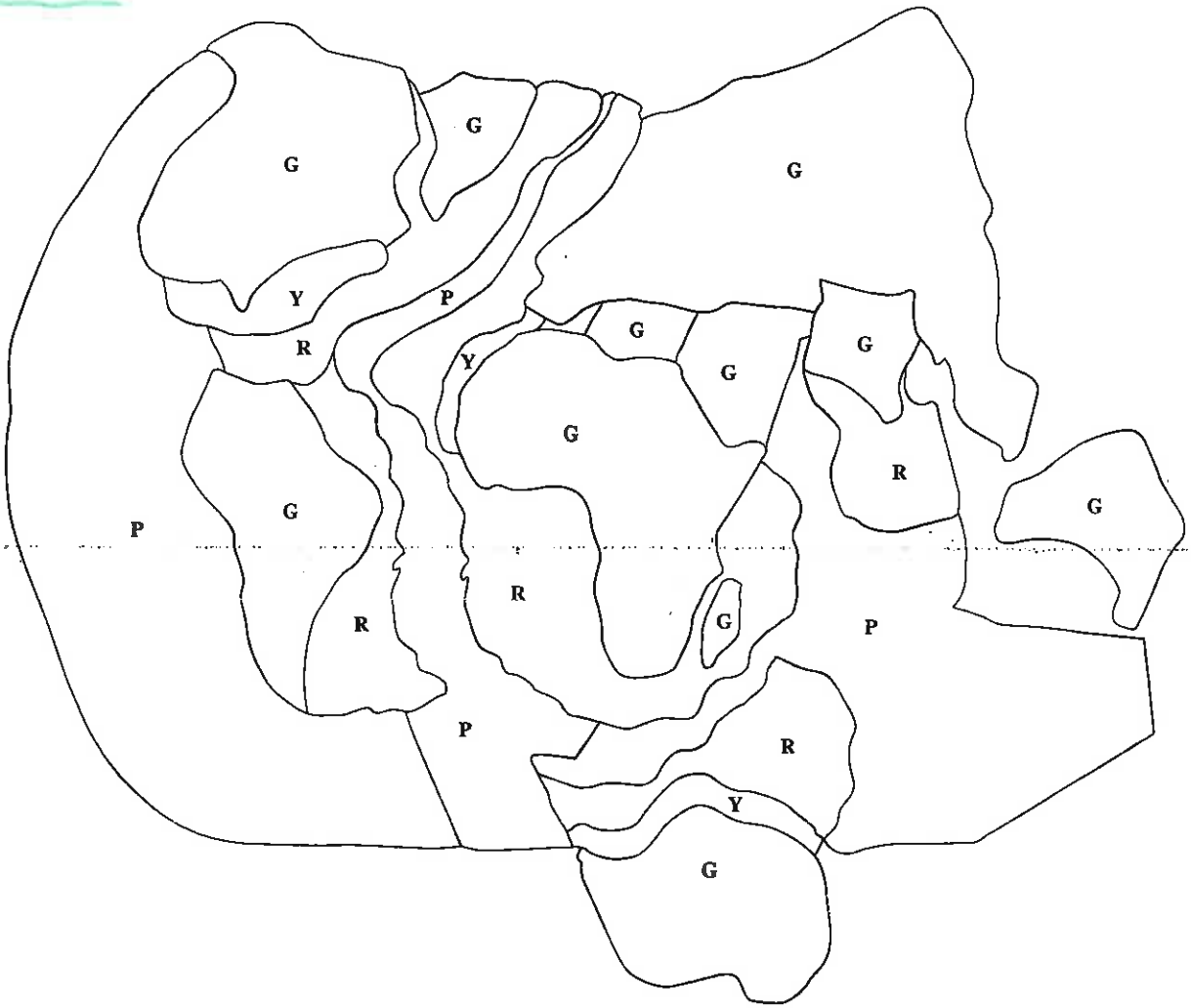

Figure 3. Current Ocean Floor

Name: _____

8. Obtain a dry-erase marker and draw lines down the center of the purple ocean crust cutouts. These lines represent the mid-ocean ridges where magma poured out onto the ocean basin and new ocean crust formed.
9. Use the dry-erase marker to label all of the purple ocean crust pieces "0-66 MY." The purple ocean crust pieces represent the ocean crust from the present day to 66 million years ago.
10. Use the dry-erase marker to label all of the red ocean crust pieces "66 to 144 MY." The red ocean crust pieces represent the ocean crust from 66 to 144 million years ago.
11. Use the dry-erase marker to label all of the yellow ocean crust pieces "144 to 164 MY." The yellow ocean crust pieces represent the ocean crust from 144 to 164 million years ago.
12. Leave all of the pieces in the same configuration on the blue ocean base for Part II.
13. Answer the questions for Part I on the Sea Floor Spreading Worksheet.

Part II. The Ocean Floor 66 to 144 Million Years Ago

1. Remove the purple ocean crust pieces from the blue ocean base.
2. Push all of the continents and remaining ocean crust pieces together until they are connected. (See Figure 4). *Note:* Africa should be left in its original position as it has not moved significantly over the last 164 million years. The locations of the continents and sea floor represent their probable configuration during the Cretaceous Period.

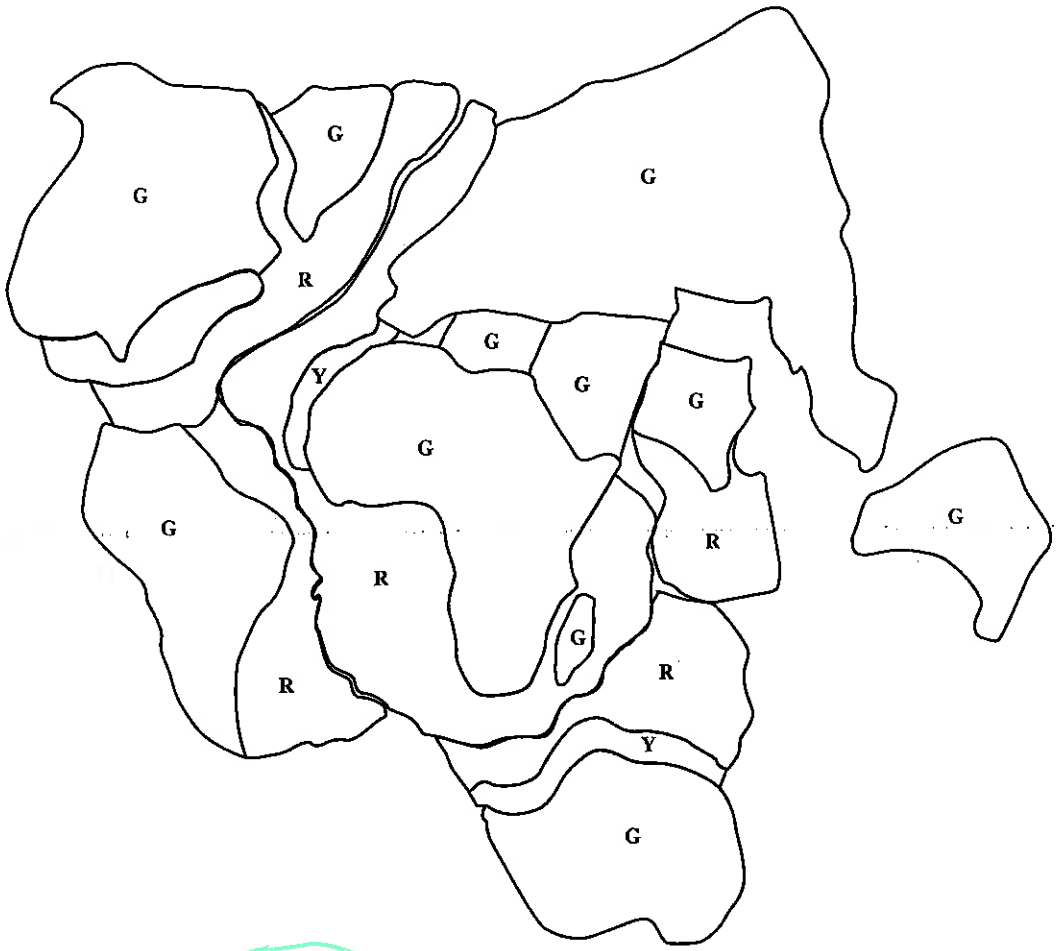

Figure 4. Ocean Floor 66–144 Million Years Ago

3. Leave all of the pieces in the same configuration on the blue ocean base for Part III.
4. Answer the questions for Part II on the Sea Floor Spreading Worksheet.

Name: _____

Part III. The Ocean Floor 144 and 164 Million Years Ago

1. Remove the red ocean crust pieces from the blue ocean base.
2. Push all of the continents and remaining ocean crust pieces together until they are connected. (See Figure 5). The locations of the remaining continents and sea floor represent their probable configuration at the end of the Jurassic Period.

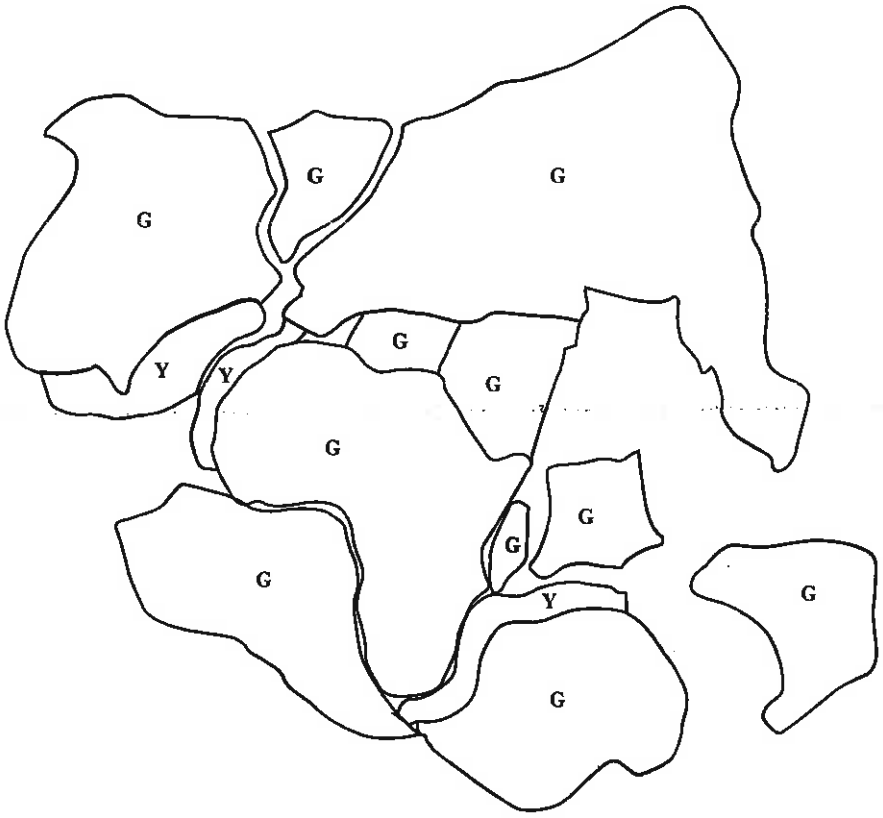

Figure 5. Ocean Floor 144–166 Million Years Ago

3. Remove the yellow ocean crust pieces from the blue ocean base.
4. Push all of the continents together into one large land mass (see Figure 1 from the *Background* section). The resulting land mass represents the supercontinent Pangaea.
5. Leave all of the pieces in the same configuration on the blue ocean base for Part IV.
6. Answer the questions for Part III on the Sea Floor Spreading Worksheet.

Name: _____

Part IV. Evidence of Continental Drift

1. Notice that a single large ocean surrounds the Pangaea land mass. Using a dry-erase marker, label this ocean Panthalassa on the blue ocean base.
2. Notice the small sliver of water between Eurasia and the Adriatic Promontory. This is the Thetys Sea. Label this sea on the blue ocean base.
3. Evaporite (water-soluble mineral sediments) and calcium carbonate deposits have been found in North America, Europe, and Africa. Using Figure 6 as a guide, label these deposits with a dry-erase marker on the continental plates with triangles.

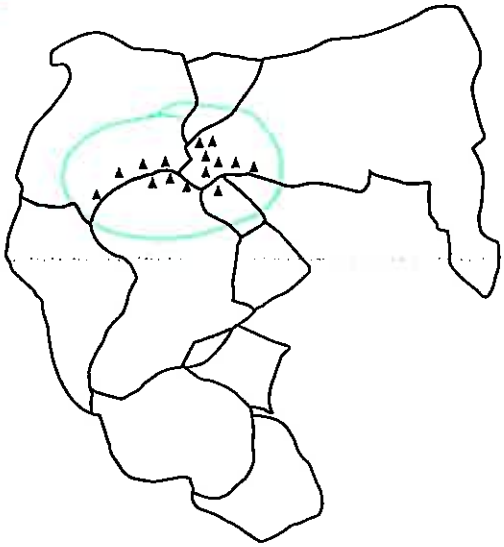

Figure 6. Evaporite and Calcium Carbonate Deposits

4. Every continent consists of a stable core crust mass called a craton. Cratons are classified into four groups based on their structure. In Figure 7 (on page 7), four different types of cratons are shown—shield, extended crust, platform, and basin. They are identified as follows:

1 *Shield*—rocks crop out from the surface

2 *Extended crust*—area where crust is pulled apart or rifted

3 *Platform*—covered by sedimentary rock

4 *Basin*—a low sinking region

Name: _____

5. Use a dry-erase marker to mark the location of the four types of cratons on the South America and Africa continental plates, as shown in Figure 7.

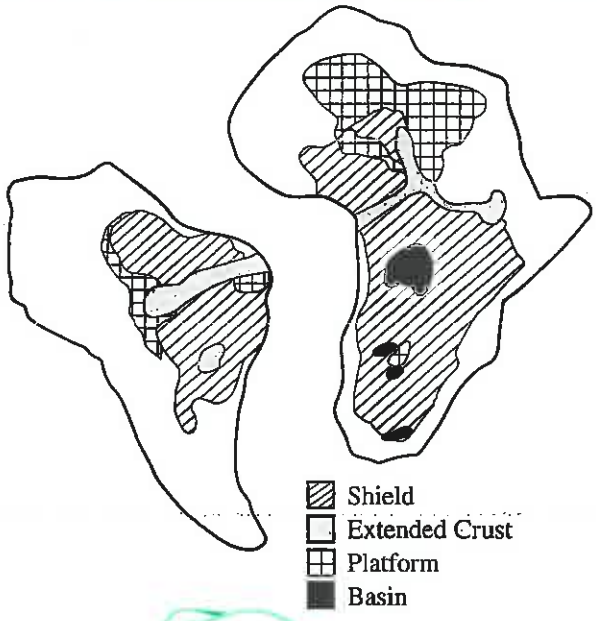

Figure 7. Cratons

6. Place the South America and Africa plates next to each other and note how the different cratons line up.

7. Fossils of the reptile *Mesosaurus* are found in both South America and Africa, while fossils of the plant *Glossopteris* are found in Africa, India, Antarctica, Australia and South America. Using a dry-erase marker, draw the locations of these fossils as shown in Figure 8.

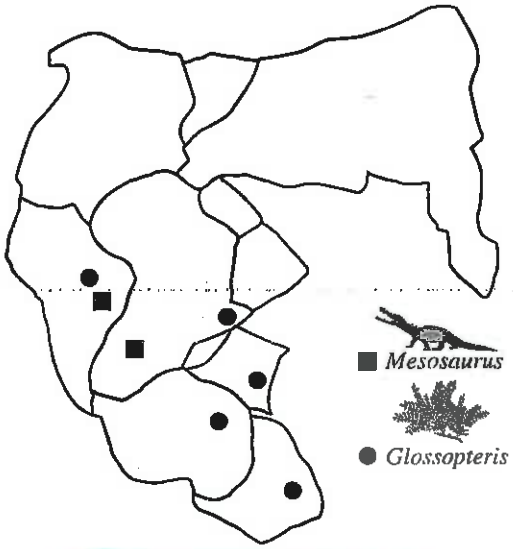

Figure 8. Fossil Evidence

8. Answer the questions for Part IV in the Sea Floor Spreading Worksheet.

Name: _____

Sea Floor Spreading Worksheet

Post-Lab Questions

Part 1

1. What do you observe about how the shapes of the continents and ocean crust pieces fit together?

2. Define sea floor spreading. Where does it occur?

3. Briefly describe the basic assumptions of plate tectonics. What geologic features or events occur at plate boundaries?

Part II

1. How do the overall size of the oceans 66 million years ago compare to the size of today's oceans?

2. From your observations, what can you conclude about the strength or durability of the continent landmasses?

3. What time period does the continent/ocean floor configuration formed in Part II represent?

Name: _____

Part III

1. What geological time period does the continent/ocean floor configuration formed in step 2 of Part III represent? What was the most well-known type of organism alive during this time period.

2. How well do the continental plates fit together?

3. When did the supercontinent Pangaea form?

4. Record all observations about the assembled simulated Pangaea landmass.

Part IV

1. Define continental drift.

2. Name the three types of evidence that support continental drift.

3. What is a craton?

4. Explain, in your own words, the relevance of the following evidence regarding the existence of Pangaea:

   Evaporite and calcium carbonate rock locations.

   The types of cratons found in South America and Africa.

   The fossils of *Mesosaurus* and *Glossopteris*.