Activity of the Month – June, 2008
Plate Tectonics and Contributions from Scientific Ocean Drilling

Summary
In this activity, students will use actual data from historic oceanographic cruises to examine sea floor spreading. They will also model sea floor spreading at a spreading center such as the Mid-Atlantic Ridge.

Learning Objectives
Students will be able to:
• Plot data on a diagram.
• Draw conclusions from the data.
• Make predictions about future events related to this data.

National Science Education Standards
• Content Standard A: Science as Inquiry; Students in grades 5-8 can begin to recognize the relationship between explanation and evidence.
• Content Standard D: Earth and Space Science; Student’s study of earth’s history provides some evidence of the distribution of land and sea and features of the crust.

Target Age: Grades 5-8
Time Estimate: 2 to 3 class periods

Materials
• PowerPoint “Stories From the Sea Floor,” available on-line at www.deepearthacademy.org
• Student Handout
• Posterboard / cardstock
• Paper
• Scissors

Background
Using actual data from the Glomar Challenger cruises will allow student to see a real-world connection between classroom science and “real” science. Also, creating a model for sea floor spreading will allow students to see a hands-on example of this phenomenon.
What To Do

Part 1
1. Students will need to cover basic information on sea floor spreading and the movement of tectonic plates. Some great sources for information are http://library.thinkquest.org/17457/platetectonics/1.php and http://www.ucmp.berkeley.edu/fosrec/Metzger3.html

2. Be sure to discuss how our planet has changed over geologic time. (For re-creations of the movement of the plates, go to http://www.ucmp.berkeley.edu/geology/anim1.html

3. Present the PowerPoint “Stories from the Ocean Floor.” Students will follow along with the Student Materials, filling in words that are underlined in the PowerPoint.

Part 2
1. To create a working model of sea floor spreading, follow the model seen below. The base is best if made from poster board or card stock. The width and length of the base are not critical, as long as they are at least 12 cm wide and 30 cm long. Cut 3 slits, each slightly more than 8 cm wide. One slit needs to be in the center, and the other two at either end of the base, at least 4 cm in from the ends. (You can cut the slits ahead of time using an Exacto knife.) Label the slits A and B at either end.

2. For the models of the plates, print out the templates (Page 3).

3. Cut out the plate strips and place them back to back (marked sides together with number 1 at the top) and tape the end as indicated (at the end nearest number 7.

4. Put the two strips up through the bottom slit and then off to the slits at either end of the base. (Figure 2.)

Procedure for students
5. Thread the two strips through the center slit of the base, keeping the taped edge at the bottom. Pull the “North American Plate” strip down through slit “A” and the “Eurasian Plate” strip through slit “B”.

6. Push the strips up from below until you can see numbers 3, 4, and 5 on top of the base.

7. Hand out the student pages. When students have all completed their models and analysis, lead a discussion about their answers and observations.

Submitted by: Jan Fechhelm, College Station, Texas, School of Rock 2007
Eurasian Plate    Eurasian Plate    Eurasian Plate

7     6     5     4     3     2     1

North American Plate    North American Plate

7     6     5     4     3     2     1
1. The __________ __________ _______________ _______________ was begun in 1964 and was designed to investigate the evolution of ocean basins by core drilling of ocean sediments and underlying oceanic crusts.

2. The data used in this exercise were taken from cores collected by the drill ship_________________________ on a cruise in _______. The Deep Sea Drilling Project was the first of 3 international ocean drilling programs that have continued right up to today.

3. Remember that the ________ on the surface of the Earth have ______________ ______________ throughout the Earth’s history.
   These diagrams show what the Earth looked like _____ _______ _______ ______

4. When scientists drill into the sea floor, the ___________ __________ are at the __________, and the ___________ ____________, those that are just settling to the bottom of the ocean, are ____ _______ __________.

5. On the third expedition of the ship (Leg 3) the crew drilled 17 holes at 17 different sites along an ___________ between ____________ and ______________________

6. What they found astonished many around the world and opened up a whole new area of scientific investigation.

7. When ocean cores are drilled, scientists can then look at the _____________ of ancient organisms found in the sediments.

8. From years of study, scientists can tell the ________ of sediments by looking at the fossils.

9. Some organisms (or their fossils) are used as ___________ _____________________________

10. This means that if those organisms are found, scientists can tell the age of the sediments, or when they were ____________ on the __________________.

11. There are 3 main groups of microscopic organisms that scientists use.
   (1) __________________________
   • _______________ (0.2 to 2 microns!) 1 micron (or micrometer) = 1 X 10^-6 or 1/1,000,000
     Often occur in massive “blooms” in the ocean (so large they can be seen in satellite pictures).

   (2) __________________________
   • _______________ up to the size of a grain of sand.
     Also can occur in massive “blooms” in the oceans.

   (3) __________________________
   • _______________
     Very important in the dating of ancient deep sea sediments.
Part 1: Just the Facts!

Use the data below and write the age of the sediments found at each site on the map below. (Write the age on the line by each site.) Then answer the questions on the next page.

<table>
<thead>
<tr>
<th>Site</th>
<th>Age of Sediments (in millions of years)</th>
<th>Distance from Ridge (in km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>40</td>
<td>745</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td>422</td>
</tr>
<tr>
<td>16</td>
<td>11</td>
<td>221</td>
</tr>
<tr>
<td>17</td>
<td>33</td>
<td>718</td>
</tr>
<tr>
<td>18</td>
<td>26</td>
<td>506</td>
</tr>
<tr>
<td>19</td>
<td>49</td>
<td>1010</td>
</tr>
<tr>
<td>20</td>
<td>67</td>
<td>1303</td>
</tr>
<tr>
<td>21</td>
<td>&gt;76</td>
<td>1686</td>
</tr>
</tbody>
</table>

From Fig. 7 in the Initial Reports of the Deep Sea Drilling Project, Volume III, p.460
Plate Tectonics and Contributions from Scientific Ocean Drilling

Conclusions: (Please write in complete sentences!)
1. Where are the youngest sediments found, compared to the Mid-Atlantic Ridge? ____________________________
   ___________________________________________________________________________________
2. Where are the oldest sediments found? ________________________________________________________________
   ___________________________________________________________________________________
3. Does the data support the theory of sea floor spreading? How? _________________________________________
   ___________________________________________________________________________________


Materials
Base, Templates for plates, Scissors, Tape

Directions
1. Cut out the strips representing the North American Plate and the Eurasian Plate. Place them face to face (letters on the inside) with the number 1 at the top.
2. Use a small piece of tape to attach the two strips at the bottom edge (by the number 7).
3. Insert the attached strips into the slot in the middle of the base, from the bottom.
4. Feed one strip into slot A and the other into slot B. (See diagram)
5. Push the strips up from below the base until you can see the numbers 3, 4 and 5 on the top.

Analysis and Conclusions (Complete sentences, please!)
4. What are you modeling by pushing the strips up through the base? ____________________________
   ___________________________________________________________________________________
5. What is being modeled at slits A and B as you push the strips up through the base? ________________
   ___________________________________________________________________________________
6. This model shows what happens at sea floor spreading centers, such as the mid-Atlantic Ridge.
   List at least 2 good points of this model. _____________________________________________
   ___________________________________________________________________________________
7. What are at least 2 reasons why this model is not a good model? ____________________________
   ___________________________________________________________________________________
8. Seafloor spreading is continuing today along mid-ocean ridges such as the Mid-Atlantic Ridge.
   Predict what effect this will have on the size of the ocean basin: ____________________________
   ___________________________________________________________________________________
   ___________________________________________________________________________________
   ___________________________________________________________________________________

BONUS (10 points!): Using the data, calculate the speed of the movement of the plates, in centimeters per year. (Show your work!)

The North American Plate and the Eurasian Plate are moving apart at approximately __________ cm per year.

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