Activity 2: Building a 3-D Model of the EPR

Overview

In this activity, students compare maps with higher and lower resolution, create a 3-D model of a contour map and improve their map reading skills, while further familiarizing themselves with the East Pacific Rise (EPR).

There are a number of ways to do this lesson. Three variations are presented: The "Main 3-D" model: the "More Detail" model, which expands on the main model; and the "Alternate 3-D Model", a simpler, faster method that can be done in less time and with fewer materials.

Development of Lesson

1. Tell the students that they will be making a 3-D model of the EPR, using the "EPR Vent Locations" map. Show them the "Color Coded EPR Vent Location Map" and ask them to describe the shape of that area of EPR.

2. After they have had an opportunity to describe what they see ask how they would go about building a 3-D map from that 2-D map. Show them the overhead projector image "**Low Resolution Color Coded EPR Vent Location Map**." *(Used in a Cruise 1, Activity 5, this is a very simplified low resolution version of the same map they will be using. If you did not use this map previously, take some time to orient the students to what it is. The map has been reduced to 40 squares each with a single depth reading. The resulting large squares are easily reduced to layers.)* Point out that 8 layers were stacked one on top of the other to create the 3-D model in the lower right corner. Could the same method be used for stacking the more complicated shapes of this contour map? How would they do it?

3. Have the students get into groups. Distribute one copy of "EPR Vent Locations" map to each student. Their task is to define each layer they would have to cut out and stack. They may find it helpful to trace contour lines on the map that are the same depth with the same color on both sides of the ridge. (i.e. make all instances of -2525 red; all instances of –2550 red-orange; all instances of –2575 orange and so on.) If they would like they can color in the bands between the contour lines. The goal is to see each contour line level as a distinct layer. If they were to cut out each layer and stack them how many layers would there be? (9 plus a base)

4. Ask the students to think of each contour as the edge of a sheet of foam core board. Have them write up a step by step plan for creating a 3-D model out of foam core.

Teacher Tip: The next steps are sugge

Essential Concept / Focus Question:

Contour maps are 2-D models of 3-D surfaces. How could we build a 3-D model from a contour map?

Learning Objectives

Students will be able to:

- Describe the physical features of the East Pacific Rise and use appropriate terminology.
- Explain that maps are models and discuss the significance of resolution .
- Build a 3-d model of the EPR.

National Standards:

Unifying Concepts and Processes:
- Evidence, models and explanation.

Earth and Space Science:
- Structure of the earth.

Time Frame: 2 periods

Materials:

- Overhead Projector copies of:
  - Color Coded EPR Vent Location Map
  - Low Resolution Color Coded EPR Vent Location Map
  - Illuminated Microbathymetry Detail Map

For the main 3-D model section

- "EPR Vent Locations"
  - Two copies of "EPR Vent Locations" for each group (one as a working copy, the other for the base of the 3-D models)
  - One copy of "EPR Vent Locations" for each student to color code and use as a reference for planning how

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Activity 2 (cont.)

Materials (cont.)

For the main 3-D model section (cont.)

to make a 3-D contour map. This copy with any notes they may take should go into their notebooks.

- [Optional] One copy of "3-D Directions" for each group
- Carbon paper
- 10 5"X10" pieces of 1/4" foam core
- 1 piece of 8.5" X11" foam core for each group
- Exacto knives for each group
- Fine ball point pen for tracing
- Two thumbtacks to hold the map and carbon paper in place on the foam core.
- Heavy cardboard sheet or cutting mat to cut foam core on.
- Spray adhesive
- Newspapers to cover a desk for a spraying area.
- One set of 8 markers for map coding: blue, blue-green, green, yellow-green, yellow, yellow orange, orange, red for each group

For More Detail Model:

- A small container of interior spackling paste for each group (You can buy a larger can and fill individual yogurt cups for each group. Containers must have a lid to keep it from drying out.)
- Plastic knives or other sculpture tools for spreading small amounts of spackle.

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erials to the students and let them figure it out for themselves as well.

Main 3-D Model

5. Distribute 10 5"X10"sheets of foam core board to each group. Have them mark each sheet as one of the elevations for their map. (i.e. one sheet is -2750 , one is –2725, one is –2700, and so on to –2525.)

6. Distribute carbon paper, two thumbtacks, a fine-point ball point pen (for accurate tracing) and an exacto knife to each group. Ask the students to choose one group member to line the map and carbon paper up with the edges of the foam core, one to trace each layer, another to cut it, and the fourth to line up the layers and glue them together.

Directions:

START WITH THE DEEPEST—Bottom—layer.

Alignment specialists:

- Line up the edge of the map with the edge of each sheet of foam core. It might help to hold them up to the light to adjust the foam core to line up with the bottom and edge of the map.
- Holding the Map and foam core firmly by one corner, slide the carbon paper under the map.
- Use the thumbtacks to hold the carbon paper and map in place on the foam core for tracing.

Tracers and cutters:

- Six layers will only need to be traced/cut on one side— the left or west side.
- The last four layers will be traced/cut on both t he left and right sides.
- Beginning with the layer before the one on which they have to trace/cut both sides of the foam core, the tracer should trace both sides of the next layer to make it easier to place the next piece.
- On the last two layers the tracer should include the lines that define the axial trough.

Cutters:

- Remind students with exacto knives to be careful. THEY SHOULD NOT TRY TO MAKE CUTS THROUGH MORE THAN ONE LAYER AT A TIME.

Spray Adhesive Specialists:

(Create an area in your room — well covered with newspaper to protect table tops — for the spray adhesive.)

- Be sure that you know which side goes up!
- Once you have two layers you can begin to assemble your model.
- Spray the underside of the foam core that will go on top.
- The first six layers can be lined up by the squared off edges on the bottom and right (or east) side.
- The last four layers will have to be lined up using the tracings on the layer that precedes them.

Activity 2 (cont.)

7. When all 10 layers are in place, the model should be placed under a heavy object overnight.

Teacher's Note: For another version of a layered 3-D map you can use sheets of colored foam (available at craft stores and classroom supply outlets) for the layers. The outlines of each layer can be traced onto them with carbon paper and they can be cut with scissors out of colors that correspond with the color coding for each depth.

8. Ask the students to compare their 3-D map and the higher resolution Illuminated Microbathymetry Detail Map and match up the features that they can identify. How can they use the higher resolution maps of the EPR to improve their models? Have them locate the Axial Summit Caldera Trough on both maps. It can be carved into the foam core. It can also be created by compressing the area with a pencil point or sculpture tool.

More Detail

If the students compare their models with the microbathymetry contour maps of the area they will see a lot more detail than they could see on the simple contour map that they used for this project. Using spackle they can fill in the gaps and add small rises that were not visible in the contour map they used. Once the spackle has dried (10-15 minutes) they can go on to step 8. Encourage the students to make their maps as accurate as possible.

9. Have students use markers to add color, indicating depth.
10. Distribute an 8.5"X11"piece of foam core and a second copy of "EPR Vent Locations" for each group. This is the base for their model. Glue the map to the foam core and the model onto the map. The students will spray the bottoms of their models with adhesive spray and place them in the right orientation on the longitude and latitude grid. (Hint:You could use these models as a centerpiece for a display about the SEAS competition your students are working on!)

Alternate 3-D Map Activity

If you need a quicker 3-D model idea, you can use clear plastic deli lids. Still have the students do step 1-3. When they get where they plan how they would make a 3-D map, have them think about using the lids. You need lids large enough to trace the 5"X10" "EPR Vent Locations" map on . Distribute 10 for each group of students. Have them stack them so that they can see how a series of maps drawn on them could be viewed. Using the standard red to blue color code, have the students trace the contour lines of one elevation per lid. Stack the lids to view.

Discussion Question:

What are some reasons that scientists want to have accurate maps of the ocean bottom? (To be able to return to the same spot, to know for certain that they are in the place they want to be in. The shape of the contour of the ocean bottom itself can give clues to how the ridges were formed, as well as how the plates

Materials (cont.)

For Alternate 3-D model:

- Two copies of "EPR Vent Locations" for each group (one as a working copy the other for the base of the 3-D models).
- 10 clear plastic rectangular deli lids (like those used for take out salads) that will settle one inside the next and that have a flat surface at least 5"X10" for each group.
- A set of Sharpie (or other writes-on-anything markers) in red, orange, yellow, green, and blue to use to write on the deli lids.

Directions for Creating A 3-D Map of the East Pacific Rise:

TIP: START WITH THE DEEPEST—Bottom—LAYER

In your group of four assign these 4 roles:

Alignment Specialist,Tracers, Cutter, and Spray Adhesive Specialist

Alignment specialists:

• Line up the edge of the map with the edge of each sheet of foam core. It might help to hold the map and foam core up to the light to line them up. Align the bottom and right side of the foam core with the bottom and right edge of the map.

• Holding the map and foam core firmly by one corner, slide the carbon paper under the map.

• Use two thumbtacks to hold the carbon paper and map in place on the foam core for tracing.

Tracers and cutters:

• Six layers will only need to be traced/cut on one side— the left or west side.

• The last four layers will be traced/cut on both the left and right sides.

• Beginning with the layer before the one that must be traced/cut on both sides of the foam core, the tracer should trace both sides of the next layer to make it easier to place the next piece correctly.

• On the last two layers the tracer should include the lines that define the axial Summit Caldera Trough (ASCT).

Cutters:

• Cut carefully along the contour lines.

• DO NOT TRY TO MAKE CUTS THROUGH MORE THAN ONE LAYER AT A TIME.

Spray Adhesive Specialists:

• Be sure to get the right side up!

• Spray the underside of the foam core layer that will go on top.

• The first six layers can be lined up by the squared off edges on the bottom and right (or east) side.

• The last four layers will have to be lined up using the tracings on the layer that precedes them.

• When all of the layers have been stuck together put a heavy object on the model and leave it overnight.

EPR Vent Locations