Mapping the Ocean Floor
Salad Box Bathymetry
Teacher Materials

The largest undersea canyon on the west coast of the United States is in Monterey Bay. At the head of the canyon, offshore of Moss Landing, it's less than 33 feet deep. At its mouth, it's 12,730 feet deep. Within the bay, the canyon is as deep and as steep as the Grand Canyon of Arizona.

Now, scientists from the Monterey Bay Aquarium Research Institute study canyon life and geology directly with two robot submersibles equipped with video cameras and sophisticated equipment to measure the depth and physical conditions of the sea floor and water above it. But finding out about the ocean floor and the animals that live there used to rely more on indirect methods to gather data and recreating maps and models from that data.

Key Concepts:

- The topography of the ocean floor includes mountains, canyons and other features similar to those on land.
- Data can provide us with information about things that cannot be observed directly.
- Maps and models can be constructed from data.

Summary of the Activity
Students make a contour map of the Monterey Canyon. Then they transfer the contours to transparent "salad boxes" to create a 3-dimensional picture of the canyon.

Materials List:

<u>for each student</u>
a copy of the practice map
a copy of the depth information from the Monterey Bay
pencil, colored pencils are optional

<u>for every four students</u>
6 clear plastic salad boxes (separate the tops and bottoms)
a felt pen that can write on the plastic (Vis a Vis washable pens are preferable in case students make a mistake)

Teacher preparation:
1. Duplicate the Practice Sheet and Monterey Canyon map for each of the students.
2. Make a transparency copy for you to demonstrate drawing the first contour lines on the overhead.
3. Cut the salad boxes apart, keeping the lids separate from the bottoms.
4. Distribute the salad box halves (6 tops or 6 bottoms to each pair of students)
5. You may wish to start the activity with some of the discussion questions and share various maps, including a topographic map of your area. (Topographic maps are available through USGS)

Discussion Questions

1. Referring to the practice map, where is the deepest part of the map? Where is it most shallow?
2. Where is it the steepest? Where is the slope most gradual?
3. What do you think the Monterey Canyon looks like?
4. Is it like the land, with mountains, valleys and rivers?
5. How would you find out what the Monterey Canyon is like?

6. How could you tell how far it is to the ocean floor?
7. What is the value of bathymetric maps to research scientists? To boaters?
8. Referring to the salad box model, do you think this is what the Monterey Canyon really looks like?
9. Where is it the deepest? Where is it the most shallow?
10. What could have caused the Monterey Canyon?
11. What features on land are similar to the Monterey Canyon?

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Student Materials

In this activity, you will construct a bathymetric contour map using the data sheet showing various depth soundings done in Monterey Bay. Once completed, you will use your contour map to construct a three-dimensional model of the Monterey Canyon.

Part 1:
Your teacher will give you a practice sheet to work with first.

The first step in making sense of the depth soundings is to create a contour map. Contour maps illustrate a three dimensional surface on a two dimensional sheet of paper. Each of the numbers represents the distance from the surface of the water to the ocean floor at that point. Notice that the numbers are often repeated.

To make a contour map, you will connect the points of equal depth with a single line.

1. On your practice sheet, find all the 10s. It may help to circle or underline them.

2. Using a pencil, connect the 10s with a contour line. Contour lines should be smooth and rounded rather than sharp and angular. In general, a contour line surrounds a section of land, at that depth. Since a single point on the ocean floor cannot be more than one depth, you will never have 2 contour lines crossing one another.

3. Now find all the 20s. Connect them with contour lines. Notice that you are quite near the edge of the map.

4. Now find the 30s. Connect the 30s with contour lines. This sample map only covers part of the land feature that we are drawing. In this case, the contour line for the 30s will have to extend off the edge of your map.

5. Sometimes there are not enough depth readings for each contour line. Notice that at the top of your map, a 20 and 40 are close together and there is no 30 in between. In this case, you need to estimate the location of the 30 in between the other numbers and draw your contour line accordingly.

6. Contour lines that are close together indicate a steep slope, whereas contour lines that are farther apart indicate a more gradual slope.

7. Finish by connecting the 40s and comparing your contour drawings with those of your teacher and classmates.

Part 2:
After you are satisfied with your sample map, get a copy of the Monterey Bay data from your teacher.

Using a pencil, connect equal depth sounding points with contour lines. Begin at a depth of 50 meters and finish at a depth of 2500 meters. Remember, a contour line never ends, it either connects back with itself, or extends off the edge of the map.

Check your drawings with your partner and teacher. After all of the contour lines have been drawn and checked, use a pen to darken all the lines, including the line that represents the coastline.

Part 3:
Now with your partner, you are going to take the your two-dimensional bathymetric map and use it to make a three-dimensional model of the canyon.

1. Select six salad box halves that match.

2. Place the fist lid (concave side up) over your bathymetric map. Align the margins and lightly draw a line on your map around the salad box. This will help you to align the remaining boxes.

3. Using a felt pen provided by your teacher, trace and label the coastline. Set this box aside.

4. Align your second salad box and trace along the 500 meter contour.

5. Repeat with the remaining boxes at the 1000, 1500, 2000 and 2500 meter contours.

6. When you have finished, stack your salad boxes in order, with the 2500 meter contour on the bottom and the coastline contour on the top.

Consider the following questions:

1. Do you think this is what the Monterey Canyon really looks like?
2. According to your model, where is it the deepest? Where is it the most shallow?
3. Where is it the steepest? Where is the slope most gradual?
4. What could have caused the Monterey Canyon?
5. What features on land are similar to the Monterey Canyon?

Practice Map