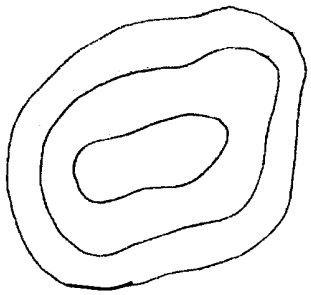
Mountain Making - Topographic Maps

Lesson by Kathy Fuchigami, Salinas, CA
Developed for the NSF Monterey Bay Aquarium Teacher Instituite

Key Concepts

1. Natural features on the earth, such as mountains and valleys, can be represented on a two-dimensional map.

2. Geologists and oceanographers use maps of the sea floor as tools to help explain tectonic processes such as plate movement.



Background

Maps catalog and display a wealth of information. On land, topographic maps provide an image of the shape of the land. At sea, bathymetric maps provide an image of the bottom of the oceans. Turning three dimensional objects like mountains or guyots into accurate two-dimensional representations on a map is a complicated process involving many steps. "Mountain Making" provides a hands-on introduction to some of the elements of this process.

Information on topographic maps as well as demonstration models can be obtained from:

U. S. Geological Survey
Education Office
345 Middlefield Road
Menlo Park, CA 94025
(415) 329-4006

Materials

For the class:

- overhead projector/plastic transparencies/ pens
- 1 road map
- 1 climate or geologic map *
- 1 three-dimensional topographic map*

*Can be borrowed from the U.S. Geological Survey Education Office

For each group of 4 students:

- 30 cm dental floss
- 1 ruler
- desk cleaner/paper towels to clean desks after the activity

For each student:

- playdough (recipe follows)
- scratch paper
- pen or pencil

PLAYDOUGH RECIPE: (This makes enough for demonstrations)

2 cups water
2 tbs. cooking oil
1 cup salt
1 tsp. cream of tartar
3-4 cups flour
food coloring

Heat all ingredients but the flour in a sauce pan until the mixture boils. Remove the pan from the heat and add the flour one cup at a time until you have a thick dough. It will feel somewhat like sugar cookie dough. Remove the dough from the pan and knead it on a floured surface until it is smooth and non-sticky. You may add more flour, water or cooking oil to enhance the consistency. ***CAUTION*** AT THIS POINT, THE DOUGH IS VERY HOT! THIS DOUGH IS NOT MEANT TO BE EATEN!

The dough can be scented to your preference with oil of peppermint or cinnamon. If you decide to scent the dough, add it after you remove the liquid mixture from the heat. The dough stores best refrigerated in covered containers or plastic zip-lock freezer bags. While it will keep for about 2 weeks in the containers, students seem to want to take it home, thereby eliminating storage problems!

Teaching Hints

In this activity, the students will understand the process by which a three-dimensional structure like a mountain is turned into a two-dimensional representation on a map. First, students use a playdough mixture to create a mountain. By measuring, marking and then slicing their mountains with dental floss in vertical increments, they will be able to explain the concept of "contour interval". The students then trace, in pencil, the outline of the base of each increment on a piece of paper, creating a topographic representation of their mountain.

Procedure:

1. Recall the idea of a map with the students. What does a map show you? Write student ideas from this discussion on the chalkboard or overhead.

2. Display a road map and ask what it shows. Ask students for specific reasons why they would use such a map.

3. Display a geologic map and ask what it shows. Why would students use it? Lead students to understand that there are different kinds of maps that show different kinds of things. There are a variety of reasons to use one or the other. For example, a geologic map would be a poor choice if you needed road information for a drive from San Francisco to Seattle.

4. Display the three dimensional map (usually made of molded plastic) and ask the same questions: What does THIS map show you? When would you use a map like this? Emphasize that this map is wonderful for showing the ups and downs of the land (elevation changes), but not convenient to carry in your pocket when you are hiking!

5. Tell the class that today they will learn how to turn the three dimensional plastic map into a two dimensional paper map that can be folded up and taken along on a hike.

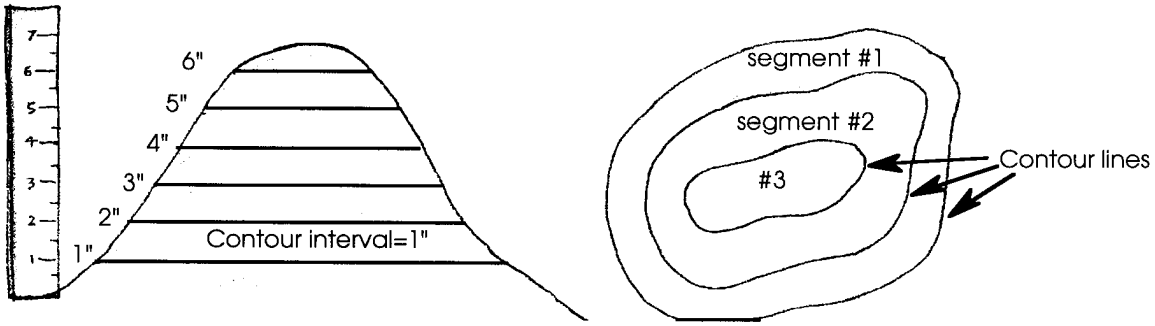
6. Demonstrate the procedure on the overhead projector:

   a. Create a steep mountain out of playdough.

   b. Hold the ruler vertically with the 1 inch mark at the bottom and the end resting on the overhead platform. Press the ruler into the mountain vertically and mark the mountain in 1 inch increments. Introduce the terms “contour line”, “contour interval”, “sea level” and “elevation”.

   c. Remove the ruler and review what you have done so far.

   d. Use dental floss to cut the mountain into segments at each contour line (the 1 inch increments).



   e. Turn the three dimensional mountain into a two dimensional representation. Separate the segments. Beginning with the largest (bottom) segment, trace the bottom of each segment onto a transparency. To represent increasing elevation, trace each succeeding segment inside the preceding, larger one. Segment #2 (the next one up from the bottom) is to be traced inside the outline of segment #1, and so on.

f. Discuss where sea level might be on the map. Identify the contour lines (where the clay is cut with dental floss) and discuss the contour intervals (for example, 1 inch on the map might represent 100 feet of elevation).

7. Have students collect their materials and begin making their own mountains.

8. Place the following questions on the chalkboard for students to copy and answer:

QUESTIONS TO BE ANSWERED BY STUDENTS

1. Draw a picture of your mountain before you slice it (side view).
   (Answers will vary.)

2. Draw what your three dimensional mountain looks like when you turn it into a two dimensional picture.
   (Answers will vary.)

3. Based on what you learned today, write a definition for:

   contour interval - (the difference in elevation between two succeeding contour lines)

   contour line - (line on a topographic map indicating a specific elevation along its entire length)

   elevation - (distance above sea level)

   sea level - (level of the surface of the sea, used as the starting point for measuring elevation above as well as depth below the surface)

4. If your contour interval was 50 feet, how tall would your mountain be?
   (Answers will vary.)

5. Do you think there are contour lines below sea level? (While contour lines are useful in making bathymetric maps, they are constructs and do not really exist below the surface of the sea.)

6. Why would people want to use a topographic map? A map of the sea floor?
   (These maps represent three dimensional objects on two dimensional surfaces and show geologic features which help scientists study origin of

the earth; help fishers set their gear at a particular depth; help hikers know how steep the trails are; etc.)

9. As mountains are being made, call students' attention to the questions and note that question 1 should be answered before the cutting begins.