Creating a 3D Physical Model and Corresponding Topographic Map

Objectives: The student will

- Observe surface details of an actual landform
- Create a three-dimensional model of an actual landform incorporating appropriate vertical and horizontal scale
- Calculate scale using given dimensions of the actual landform and measuring dimension of the model
- Create a topographic map based on his/her model
- Demonstrate relationship between contour density on the map and steepness of slope on the model

Materials:

- Clay
- Food Coloring (blue and green work well)
- Tongue depressors or other implements to smooth clay
- 12”X24”X12” clear plastic boxes
- 14” X 26” or larger piece of clear plexiglass
- 14” X 26” or larger piece of acetate
- Fine-point markers
- Plastic Rulers marked with centimeters
- Large beakers

Background:

- Discuss necessity of having a two-dimensional map to represent 3-dimensional Earth. Discuss history of mapping and qualities of good cartographers and how those qualities also characterize scientists.

Part I: Building a Physical Model

- Observe actual landform; look for uneven areas in the surface, gullies, peaks. Many students will tend to oversimplify the landform (ie show a mountain as a simple cone). The observation period is to hone the student’s ability to notice, and later represent, surface detail.
- Have the students work in pairs or small groups to build a clay model of the actual landform. In introducing the activity, emphasize the concept of a scale model (ie that the ratio of height to length in the model must equal the ratio of height to length in the actual landform).
- Whole class: Calculate the ratio of height to length for the actual landform. Using this ratio, determine the final dimensions of the model landform that will fit completely
within the plastic box with the lid on it. Mark these dimensions on the side of the box using markers.

• Build the model, reshaping the clay as necessary to present as detailed and accurate a model as possible. Check final dimensions to make sure that their ratio equals the ratio of the actual landform.

Part II: Creating a Topographic Map from the Model

• Tape the plastic Ruler to the inside of the plastic box containing the clay model so that the base of the ruler is against the bottom of the box, and the top of the ruler is above the highest point on the model.
• Fill box with enough water to reach the 1cm line.
• Cover the box with the plexiglass cover, and tape a piece of acetate to the cover.
• Trace the line that marks the margin between the water and the clay being careful to look straight down on the line. This line is your first contour line.
• Fill box with 1cm additional water.
• Replace cover, and draw a second contour line, which should be completely within the first contour line.
• Repeatedly add 1cm of water and draw new contour lines until the model is completely submerged.
• Remove acetate with contour map and place on a light-colored surface.
• Empty water from the plastic box, and trace a path on the landform. Have students show the corresponding path on their map.
• Point out high points on the model, have students find corresponding points on the map.
• Have students find the steepest part of the model, and show the steepest areas on the map. Point out that these places have closely-spaced contour lines while flatter spaces have contour lines further apart.

Part III:

• Using USGS topographic maps, have students identify peaks, steep areas and flat areas and explain how they determined the relief of the landscape by interpreting the spacing of contour lines.