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## Hudson Canyon Expedition

# Mapping the Canyon

### Focus
Bathymetry of Hudson Canyon

### Grade Level
9 - 12

### Focus Question
What are the differences between bathymetric maps and topographic maps?

### Learning Objectives
Students will be able to compare and contrast a topographic map to a bathymetric map.

Students will investigate the various ways in which bathymetric maps are made.

Students will learn how to interpret a bathymetric map.

### Adaptations for Deaf Students
None required

### Materials
**Part I:**
- ❒ 1 Hudson Canyon Bathymetry map transparency
- ❒ 1 local topographic map
- ❒ 1 USGS Fact Sheet on Sea Floor Mapping

**Part II:**
- ❒ 1 local topographic map per group
- ❒ 1 Hudson Canyon Bathymetry map per group
- ❒ 1 Hudson Canyon Bathymetry map transparency
- ❒ Contour Analysis Worksheet

**Part III:**
- ❒ Library Books

### Audio/Visual Equipment
Overhead Projector

### Teaching Time
Two 45-minute periods

### Seating Arrangement
Cooperative groups of two to four

### Maximum Number of Students
30

### Key Words
Topography
Bathymetry
Map
Multibeam sonar
Canyon
Contour lines
SONAR
Side-scan sonar
GLORIA
Echo sounder

### Background Information
A map is a flat representation of all or part of Earth's surface drawn to a specific scale (Tarbuck & Lutgens, 1999). Topographic maps show elevation of landforms above sea level, and bathymetric maps show depths of landforms below sea level. The topographic elevations and the bathymetric depths are shown with contour lines. A contour line

is a line on a map representing a corresponding imaginary line on the ground that has the same elevation or depth along its entire length (Tarbuck & Lutgens, 1999).

Since the ocean floor is not visible to us, it is difficult to map. Scientist use various techniques to gather data for a bathymetric map. In the early 1800's, mariners took depth records in shallow waters with a weight on a line. Then in 1854, a depth-sounding device was attached to the line instead of the weight. This made determining when the line hit the bottom of the ocean easier; however, recording a small section of the ocean still took hours or even up to a day. Because the ocean is so large and deep, this procedure is not feasible. As a result, mapping the seafloor takes much longer than it takes to map areas on land.

During World War II, when submarine warfare was the highest in the Atlantic and Pacific Oceans, sonar developed rapidly. Sonar devices use echoes from the ocean floor to measure ocean depth (Metzger, 1999). After World War II, with the increased use of sonar, hesitations about a featureless seafloor where dispelled. Scientists were able to map ocean trenches, ridges, plains, and submerged islands.

Today, scientists are working on advances to make sonar more accurate. They have created a side-scan sonar device called GLORIA (Geologic Long-Range Inclined Asdic). Side-scan sonar is towed behind a vessel and is able to scan the depth along the sides of the vessel as well as the depth directly below the vessel. GLORIA has been able to make detailed maps of the continental margin along the North American coast. Another advance to sonar is the multibeam sonar. By emitting signals of different frequencies, multibeam sonar allows for a detailed three-dimensional map of the seafloor. Even with all of these new advances in bathymetric mapping, only a limited portion of the vast seafloor has actually been mapped.

## Learning Procedure

**Part I**:

1. Introduce topographic maps and bathymetric maps to the students
2. Hand out USGS Fact Sheet on Sea Floor mapping

**Part II:**

1. Have student groups gather the following materials:
   a. 1 local topographic map per group
   b. 1 Hudson Canyon bathymetry map per group
   c. 1 Contour Analysis Worksheet per student
2. Have students observe and analyze the two different maps using the Contour Analysis Worksheet.

**Part III:**

1. Have student groups research and give presentations on the different techniques used to collect depth data for bathymetric mapping.
2. Topics could include:
   a. Echo sounder
   b. Seismic reflection profiles
   c. Multibeam sonar
   d. Weighted wires
   e. Sonar
   f. GLORIA
   g. World War II and sonar

## The BRIDGE Connection

woodshole.er.usgs.gov/epubs/openfiles/ofr98-616/titlepage.html

## Connection to Other Subjects

English/Language Arts, Mathematics

## Evaluations

Students will write a paragraph summarizing what they learned about the bathymetry of the Hudson Canyon.

Teacher will review each student's Contour Analysis Worksheet.

Teacher will review presentations given by students on the various techniques used to map the bottom

of the ocean floor.

## Extensions

- Ask students to write a short essay comparing the Grand Canyon to Hudson Canyon.
- Make a clay model of the Hudson Canyon.
- Ask students to identify all of the deep-sea canyons found along the Atlantic Coast.
- Visit the Ocean Exploration Web Site at www.oceanexplorer.noaa.gov
- Visit the National Marine Sanctuaries web page for a GIS fly-through of the Channel Islands National Marine Sanctuary at http://www.cinms.nos.noaa.gov/

## References:

Maddocks, Rosalie F., 2000, Introductory Oceanography Lecture 4A: The Ocean Floor. (www.uh.edu/~rmaddock/3377/3377lecture4a.html) Department of Geosciences, University of Houston

Metzger, Ellen P., 1999, "Submarine Mountains Teachers Guide". (www.ucmp.berkeley.edu/fosrec/Metzger2.html)

Tarbuck, E.J., and Lutgens, F.K., 1999, EARTH *An Introduction to Physical Geology* (6th ed.): Prentice Hall, Inc., Upper Saddle River, New Jersey, p. 450-452

## National Science Education Standards

**Science as Inquiry - Content Standard A:**

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

**Earth and Space Science – Content Standard D**

- Structure of the Earth system

**Science and Technology - Content Standard E**

- Abilities of technological design
- Understandings about science and technology

**Science in Personal & Social Perspectives - Content Standard F:**

- Science and technology in society

**History and Nature of Science – Content Standard G:**

- Nature of science
- History of science

## For More Information

Paula Keener-Chavis, National Education Coordinator/Marine Biologist
NOAA Office of Exploration
Hollings Marine Laboratory
331 Fort Johnson Road, Charleston SC 29412
843.762.8818
843.762.8737 (fax)
paula.keener-chavis@noaa.gov

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**Student Handout**

# Contour Analysis Worksheet

1. Collect the following materials from your teacher:
    a. 1 local topographic map
    b. 1 bathymetric map of Hudson Canyon
2. What is the scale on the topographic map?
3. What is the scale on the bathymetric map?
4. Why do you think the scales are so different?
5. What is the contour interval on the topographic map?
6. What is the contour internal on the bathymetric map?
7. What do the two contour intervals indicate?
8. What do the colors represent on a topographic map?
9. What do the colors represent on a bathymetric map?
10. Why do these color schemes differ?
11. What is the highest feature on the topographic map? What is its elevation?
12. What are the latitude and longitude coordinates of this feature?
13. Locate Hudson Canyon on the bathymetric map. What is the depth of the deepest part?
14. What are the latitude and longitude coordinates of the Hudson Canyon?
15. Why is it important for the submarine ALVIN to know the bathymetry of Hudson Canyon?
16. Write a two-paragraph summary comparing and contrasting topographic maps to bathymetric maps.