POLAR TREC Learning Resources

Details

Completion Time: Less than a week
Permission: Download, Share, and Remix

Bathymetry: Mapping Mystery Bay

Overview

Many students are familiar with topographic maps showing relief of land surfaces. In this lab they will produce their own bathymetric maps, the underwater equivalent. A bathymetric map shows sea floor features by contouring depths below sea level (instead of elevation above sea level as in topographic maps). Students will first probe depths in "Mystery Bay", a box with simulated sea-floor features invisible to participants. After recording their depths on a simple grid system, students will contour their seafloors to generate a bathymetric map that allows them to visualize what is hidden beneath the bay's waters.

Objectives

- Students will understand the role of sonar systems in mapping sea-floor depths.
- Students will learn how to produce a contour map from a series of point depth readings, yielding a 2-D representation of a 3-D surface.
- Students will compare their virtual representation of the sea floor with the actual surface they mapped and evaluate their effectiveness.

Lesson Preparation

Cover each box with aluminum foil and a copy of the Mystery Bay mapping grid. Tape well, again to prevent peeking. The advantage to using this product is that every group will be mapping the same feature, facilitating easier comparison of results and making it easier to show comparable example contours. For the same reasons it is good to orient north in the same direction on each box.

This activity is a great follow-up to lessons on sea-floor features and sonar. It also may be a helpful step to begin with a sea-floor profile activity (2-D) before moving on to this 3-D surface mapping activity. If students have

Materials

- "Mystery Bay" box: 1 per group (max 4 students per group recommended.) See Resources section for details.
- Metric Rulers: 2 per group
- Bamboo Food Skewers: 2 per group.

done topographic mapping prior to this activity you can access that experience as well to remind them what contour lines mean.

Procedure

Students pierce the covering at each coordinate as instructed by the teacher (best to start with even-even coordinates only- more advanced groups can go on to odd-odd if they have time or even map them all.) By holding the bamboo skewer vertically they can probe to the hard bottom, mark the depth with a fingernail, and then measure the depth with their ruler. They then record the depth in millimeters on their mapping grid, directly at the same coordinate where they probed the depth. This is a good technique to model, showing incorrect and correct ways of measuring depths and discussing similarities and differences to actual sonar used on ships.

Bathymetry Lab Contouring Instructions:
1) Read about Bathymetry online. (http://en.wikipedia.org/wiki/Bathymetry)
2) Mapping rules: A contour line shows equal depth. Anything on a contour line is the same depth. Anything inside of the contour line is shallower, and anything outside the contour line is deeper. You may wish to see an example: http://www2.ivcc.edu/phillips/courses/gel1008/lab_help/lab6/topodraw/topodraw2.htm
3) For examples from a real-life sea-floor mapping expedition on the US Coast Guard polar icebreaker Healy using multibeam swath sonar, see these PolarTREC journal entries:
• http://www.polartrec.com/expeditions/international-continental-shelf-survey/journals/2010-08-12
• http://www.polartrec.com/expeditions/international-continental-shelf-survey/journals/2010-08-20
• http://www.polartrec.com/expeditions/international-continental-shelf-survey/journals/2010-08-25
4) Use a 5mm contour interval, drawing a 10mm deep contour, 15mm deep contour, 20mm deep contour, etc. The first few have been drawn for you as an example. Continue contours until deepest water has been mapped (85mm contour or so.)
5) Color in each contour interval when you are done.
6) Finally, sketch what you think the seafloor of Centennial Bay actually looks like on the back of your map when you are done.

Tips:
• Only depths with multiples of 5 should be on lines (e.g. 15mm, 30mm, 55mm, 70mm.)
• Contour lines may get close (steep slopes) and even overlap (vertical cliffs) but may not cross (this would break the contouring rules.)

Extension

• Produce a N-S or E-W profile across Mystery Bay. A sheet of graph paper would be needed for this.
• Produce an electronic Mystery Bay map using Microsoft Excel or other spreadsheet with

contour mapping capabilities. Hint: Enter depths as negative numbers or use the "invert data" feature.

Resources
Making Mystery Bay Boxes: The easiest way to make Mystery Bay boxes is to order enough Hubbard Scientific Contour Model Kits (Hubbard Product ID #3022) (http://www.amep.com/searchresultsdetail.asp?cid=1023). Cover the sides with construction paper, well fastened with masking or packing tape to prevent peeking. If this is all you will use these for you could also permanently paint the clear plastic (on the inside so it won't scratch off.) If using this model, also tape over the hole in the volcano (seamount in this case) crater.

Alternatively, you can make your own Mystery Bay boxes out of cardboard boxes, plastic storage bins, etc. and construct your own sea-floor features with clay (allow to dry hard before mapping) or other sculpting material that hardens.

International Continental Shelf Survey (http://www.polartrec.com/expeditions/international-continental-shelf-survey)

- Hubbard Scientific Contour Model Kit (Hubbard Product ID #3022) (http://www.amep.com/searchresultsdetail.asp?cid=1023)
- http://en.wikipedia.org/wiki/Bathymetry
- http://www2.ivcc.edu/phillips/courses/gel1008/lab_help/lab6/topodraw/topodraw2.htm
- http://www.polartrec.com/expeditions/international-continental-shelf-survey/journals/2010-08-12
- http://www.polartrec.com/expeditions/international-continental-shelf-survey/journals/2010-08-20
- http://www.polartrec.com/expeditions/international-continental-shelf-survey/journals/2010-08-25

Assessment
Reveal the sea floor model to students after their sketches are done and then give them time to self-evaluate their sketches. Student maps will be pretty comparable to an example (included in the associated files for this lesson) for assessment. Watch for places where the contouring rules were broken, such as having depths outside of the correct range within a certain contour interval. Check student sketches and comments about their accuracy and give feedback as appropriate.

Credits
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National Science Education Standards (NSES)

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard D: Earth and Space Science
a. Structure of the earth system

Content Standard E: Science and Technology
a. Abilities of technological design
b. Understandings about science and technology

Content Standard G: History and Nature of Science
a. Science as a human endeavor
b. Nature of science
c. History of science

Content Standards, Grades 9-12

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

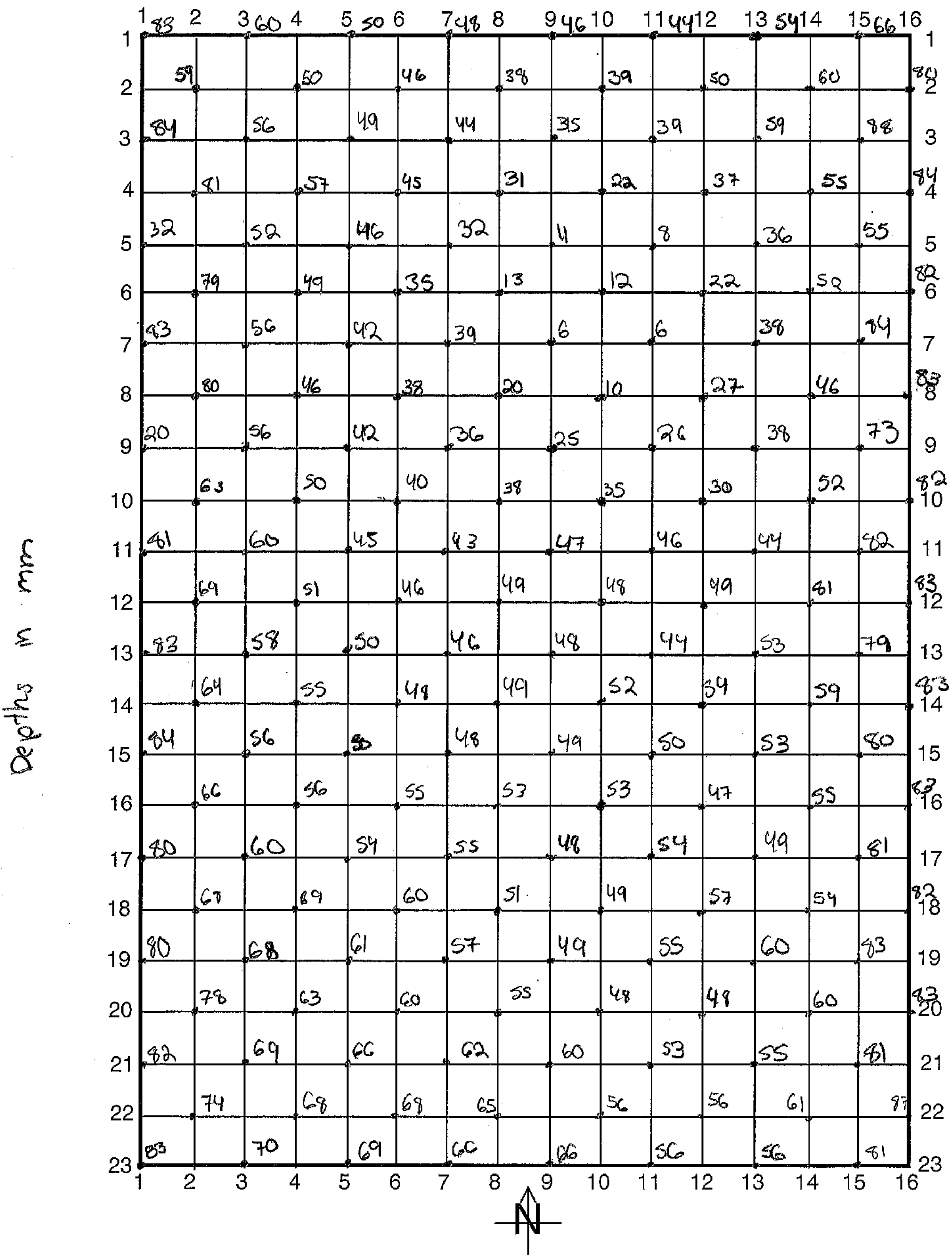
Content Standard E: Science and Technology
a. Abilities of technological design
b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives
f. Science and technology in local, national, and global challenges

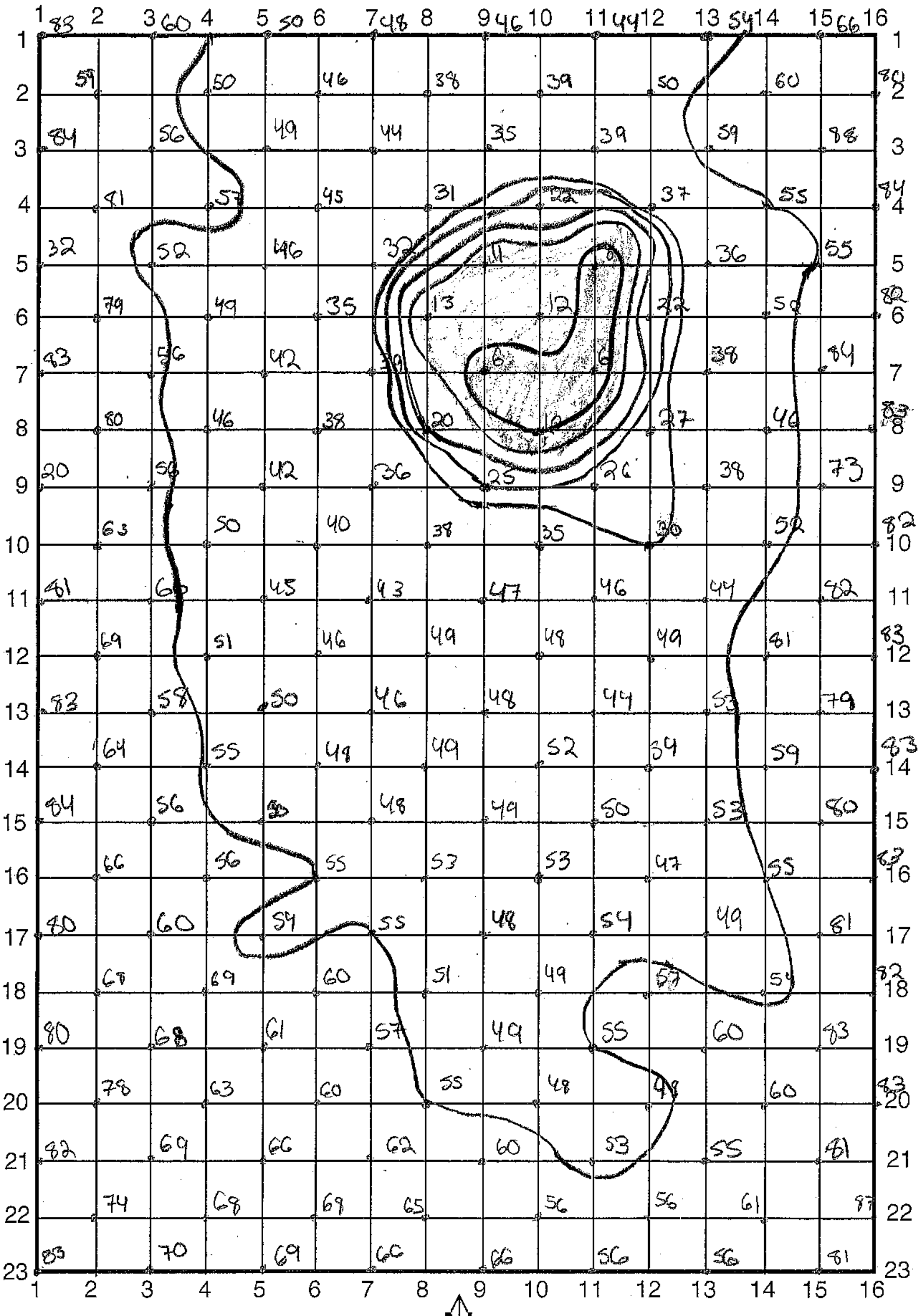
Content Standard G: History and Nature of Science
a. Science as a human endeavor
b. Nature of scientific knowledge
c. Historical perspectives

Other Standards
N/A

Centennial Bay



Centennial Bay



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Depths in mm