Simulating Ocean Floor Mapping

Grades: 6-8 & 9-12	Implementation Practice: Investigation - Simulation
Subject Area: Earth Science	Estimated Duration: two 45 min sessions

Objectives:
Students will be able to:

- **identify** seafloor features
- **simulate** using sonar to map the seafloor
- **construct** a graph to represent seafloor depth data over distance
- **construct** a contour map of the seafloor using collected data

Standards Addressed

NGSS	**Performance Explications**		
	Middle School **MS-ESS2-2**. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.		
	High School **HS-ESS2-1**. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.		
	Disciplinary Core Ideas	**Science and Engineering Practices**	**Crosscutting Concepts**
	• ESS2.A: Earth's Materials and Systems • ESS2.B: Plate Tectonics and Large-Scale System Interactions	• Analyzing and Interpreting Data • Developing and Using Models • Planning and Carrying Out Investigations	• Patterns • Scale Proportion and Quantity • Systems and System Models • Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Advance Preparation

- Obtain or make a 3-D seafloor model. Note: it can take up to five days for the salt dough to cure. One class period can be dedicated to making the seafloor models.
- Gather materials:
    - 3D seafloor model or materials to make one: shoe box and salt dough
        - Salt dough: flour, salt, water, and a bowl to mix it in
    - Aluminum foil
    - 1cm grid paper
    - Wooden skewers
    - Ruler with metric markings
    - Pencil with eraser
    - Tape
    - Marker
    - Graph paper or access to spreadsheet program (e.g. Excel)

Lesson Plan

Part I

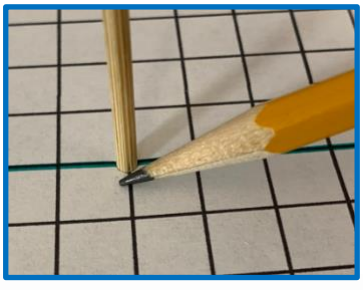
1. Obtain or make a 3-D seafloor model. It is relatively easy and fun to make a seafloor model out of salt dough and a shoe box. The ratio for salt dough is 2 cups flour to 1 cup salt to 1 cup warm water.

> **Note:** it can take up to five days for a salt dough model to dry depending on your climate.
>
> **Optional**: Once dry, use paint or markers to color code different features of the seafloor.

2. Cover the shoe box seafloor model with aluminum foil. This represents the surface of the water. Tape down the foil. On top of the foil, tape down paper with a 1cm grid. There are multiple grid paper generators available online.

3. Mark a straight line across the grid paper using a ruler to represent a transect line. The line should extend from one edge of the grid to the opposite edge, run parallel to the long edge of the model and be roughly in the center.

4. Use a wooden skewer to simulate a sonar depth sounding beginning at 0cm and then at each 1cm mark along the transect line. Insert the skewer and keep it vertical, being careful not to let it slide down any slope on the model.



5. For each sounding point on the transect, measure the distance in centimeters that the skewer is inserted. This is equivalent to the seafloor depth. Mark the location where the skewer meets water (paper) with pencil. Carefully pull out the skewer and measure to your pencil mark. Erase the pencil mark before proceeding to the next sounding.

6. Record each depth at its proper location on the grid. Mark this data directly on the grid covering your seafloor model. Note that depth measurements (below the paper, or water line) are negative because they represent elevations below sea level.

7. Use the data to make a sonograph of the seafloor along the transect line.

If making the graph by hand:

- Record the interval between each sounding on the x-axis.
- Record the depth from the water line (paper on your seafloor model) to the seafloor on the y-axis.

If using Google sheets or Excel:

- Record the interval for each sounding in the first column
- Record the depth from the water line (paper on your seafloor model) to the seafloor on the y axis.

See the table below for an example.

Transect Length (cm)	Depth (cm)

8. Identify and label the seafloor features on the sonograph.

Part II

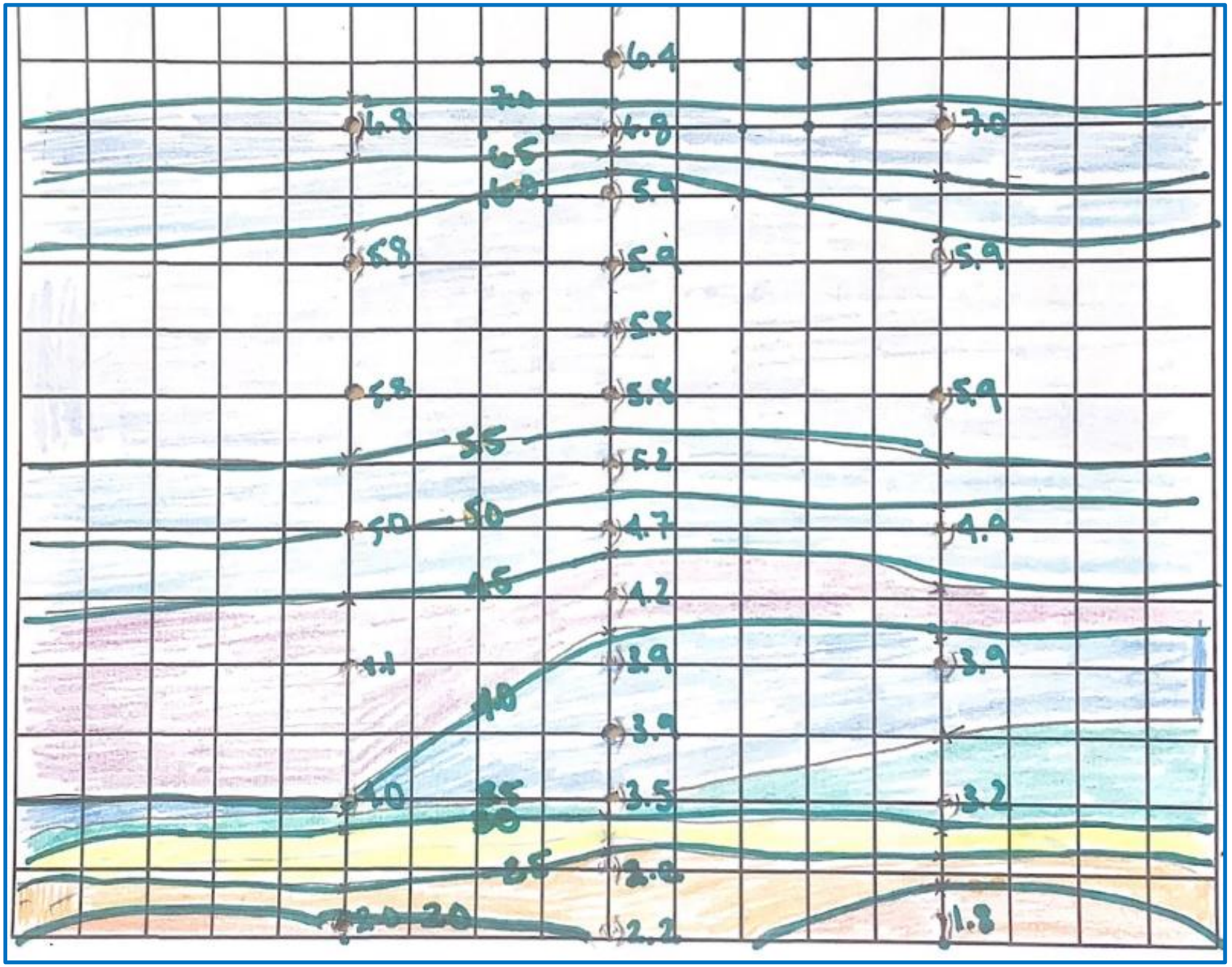
1. Draw two additional transect lines on the grid. These lines should be parallel to the first transect and each should be midway between the first transect and the edge of the model.

2. Repeat the sonar sounding simulation process with the wooden skewer on both of the new transect lines. Starting at 0cm, make a sounding every 2cm along each transect. Record each depth at its proper location on the grid.

3. Carefully remove the grid from the model. Draw 0.5cm contour lines on the seafloor grid. Make sure to label each line with its depth interval.

4. Once all the contour lines are drawn, color code each section. It is conventional to use warmer colors to indicate shallower areas and cooler colors to indicate deeper areas.

Optional: Draw the contour lines on the graph paper and color it rather than the seafloor model. Saving the seafloor model for future use. See sample below.



Sample bathymetric map with 0.5 cm contour lines and colored contour intervals. Warmer colors indicate shallower areas and cooler colors indicate deeper areas.