

# Probing Under the Surface

## Task Information

**Subject:** Earth Science

**Content:**

- NYS Syllabus (1970 ed.) Topic A1.2, Topic B2.2
- NYS Pro. Mod. Syllabus (1993 ed.) Unit 1 - D3.
- MST Framework Standard 2 Systems Modeling (Descriptive Modeling)
- Middle Level Block D - IF3 Topographic Maps

**Format:** Manipulative

**Purpose:**

To use a simple instrument to measure, record, and draw inferences about a hidden surface.

**Skills:**

**Primary:** Observing, measuring, generalizing/infering

**Secondary:** Interpreting data, predicting

**Time:** 20 minutes

**Materials:**

**per Student:**

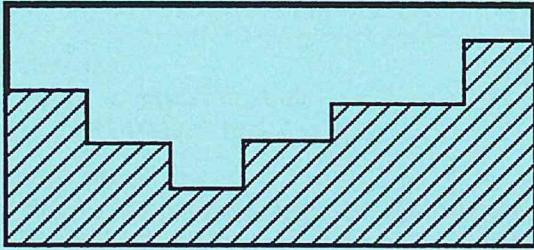
- measuring stick
- mystery box

**Preparation:**

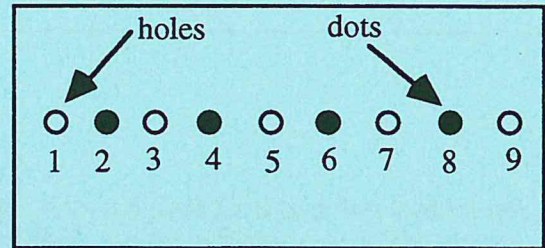
- **Measuring Stick:**
  - use a small wooden dowel or skewer 1/8" - 1/4" in diameter and at least 5 cm longer than the box height.
  - marked off in centimeters and label 0 - 15.
  - mark the dowel with a fine line permanent marker
- **Mystery Box:**
  - use a regular size shoe box.
  - cut and/or shape Styrofoam blocks to different levels. A handy knife or coarse file will do this. See diagrams below.
  - boxes must be all the same or labeled to match student papers with an answer key.
  - glue Styrofoam blocks at 3 or 4 different levels inside the bottom of the box
  - cover the tops of the Styrofoam blocks with tag board (duct tape) this keeps the measuring stick from poking into the Styrofoam. There should be a significant change between the blocks at points 3 and 5.
  - the depth between hole three (3) and hole five (5) should show significant changes.
  - on the top of the box, place a row of 10 (ten) equally distant dots.
  - number the dots 1 - 10
  - use a drill or sharp pair of scissors to poke holes through the top of the box on the odd numbered dots.
  - Be sure that the holes are large enough for the measuring stick to fit through. but not so large that you can see into the box.
  - Seal the edges of the box top on the box with clear packing tape.
  - The students should not be able to see inside the box at all during the activity.
  - measure and record the actual depth reading of each box at each dot to serve as the answer key.



**Mystery Box Diagram:**  
(side view - inside of shoe box)



(top view)



**EXTENSIONS/MODIFICATIONS:**

Students may wish to design their own hidden surfaces.

**SAFETY:**

Watch that the students don't push the probe down too hard, causing them to break the measuring sticks. .

**CREDIT/SOURCE:** AIMS, 1970 N.Y.S. Syllabus Supplement for Earth Science.



# Probing Under The Surface - Scoring Rubric

## Maximum Score 26 points

### Tasks 1 & 2 Directions

No credit

### Task 3. Data Table

7 points total

Standard: The student will measure the distance to the bottom of the box and record these data accurately and precisely in a data table.

Criteria:

- A. 1 point for **each** correct measurement +/- 1.0 cm.
- B. 1 point if **all** measurements are rounded to the nearest tenth of a centimeter.
- C. 1 point if **all** of the measurements are labeled with the correct units.

### Graph

6 points total

Standard: The student will use the data from his/her table to draw a graph representing a profile of the surface of the bottom of the box.

Criteria:

- A. 1 point if both axes are correctly labeled with variable.
- B. 1 point if both axes have appropriate scale.
- C. 1 point if both axes have correct units given.
- D. 2 points if 5 points are correctly plotted.  
1 point if 4 points are correctly plotted.  
0 points if less than 4 points are correctly plotted.
- E. 1 point if the line is correctly drawn.  
Dot to dot or best fit curve may be acceptable.

### Task 4. Shape Description

2 points total

Standard: The student will describe the shape of the bottom of the box using his/her data to draw inferences about the profile of an unobservable surface.

Criteria:

- 2 points if the statement is descriptive and is generally consistent with the table and graph using complete sentences.
- 1 point if the statement is correct but not complete sentences.
- 0 points if statement is incorrect, even if complete sentences.

### Task 5. Estimation

4 points total

Standard: The student will predict the elevation of an unknown value between two known values, and justify that prediction. The prediction should be based on the student's graph.

Criteria:

- A. 2 points for correctly estimating the value and unit at spot four (4), based on their line. (+/- 0.1 cm)  
1 point for correct value +/- 0.2 cm.
- B. 2 points for a reasonable explanation for their prediction in complete sentences.  
1 point for reasonable explanation not in complete sentences.  
0 points for unacceptable explanation

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**Task 6. Model Drawing****1 point total**

Standard: The student will draw a two dimensional representation of a three dimensional surface based on their graph data.

Criteria:

- 1 point for a drawing which matches the graph in #3.
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**Task 7. Reason for Drawing****2 points total**

Standard: The student will explain inferences based on observations.

Criteria:

- 2 points for a reasonable explanation based on their data, using complete sentences.
  - 1 point for a reasonable explanation based on their data not in complete sentences..
  - 0 points for an unreasonable explanation.
- 

**Task 8. Graph Representation****2 points total**

Standard: The student will interpret the data from the graph to make an inference.

Criteria:

- 2 points if both and only graphs A & D are selected.
  - 1 point if only graph A or D is selected, with no incorrect selections.
  - 1 point if both graphs A or D are selected, and one incorrect selection is made.
  - 0 points if 2 incorrect graphs are selected.
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**Task 9. Explanation of Limited Stick****2 points total**

Standard: The student will predict the results of the limits of measurement

Criteria:

- 2 points if a logical explanation is given that the graph would reflect the lack of data below the limits of the measuring stick using complete sentences.
  - 1 point if logical explanation is not in complete sentences.
  - 0 points if explanation is not logical.
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**Highest possible score - 26 points**

Student ID \_\_\_\_\_

# Probing Under the Surface - Scoring Form

Male or Female (circle one)

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

**1. & 2. Directions**

No credit

**3. Data table**

A. Recorded each correct measurement	0	1	2	3	4	5
B. Recorded all measurements to the nearest tenth of a centimeter	0	1				
C. Labeled all measurements with correct units	0	1				

**Graph**

A. Both axes correctly labeled with variables	0	1				
B. Appropriate scale	0	1				
C. Unit Given	0	1				
D. Points correctly plotted	0	1	2			
E. Line correctly drawn	0	1				

**4. Shape Description**

0 1 2

**5. Estimation**

A. Value of depth and units	0	1	2
B. Reasonable explanation	0	1	2

**6. Model Drawing**

0 1

**7. Reason for Drawing**

0 1 2

**8. Graph Representation**

0 1 2

**9. Explanation of Limited Stick**

0 1 2

**TOTAL SCORE** \_\_\_\_\_

Total possible score - 26 points



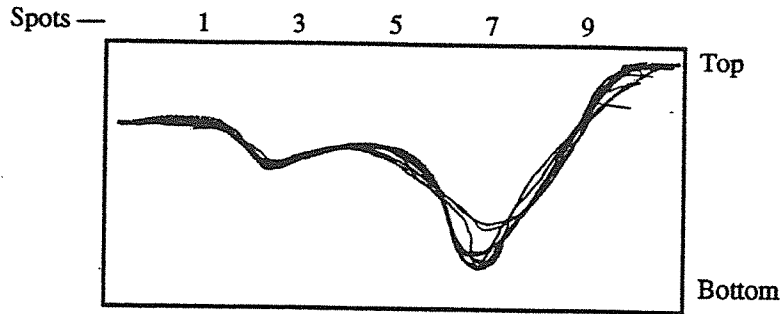
Based on your graph, predict the depth of the inside bottom of the box at spot 4.

6.2 cm

In complete sentences, explain the reason for your prediction in the space below.

If the box's bottom is sloping, point 4 should be halfway between spot 3 and 5 in both location and elevation

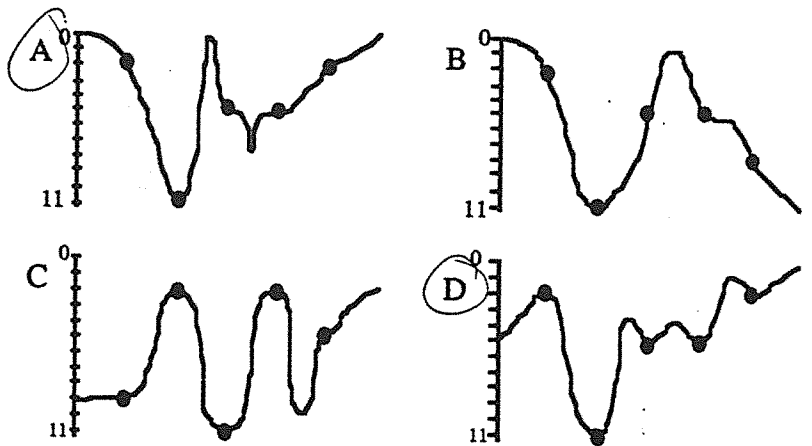
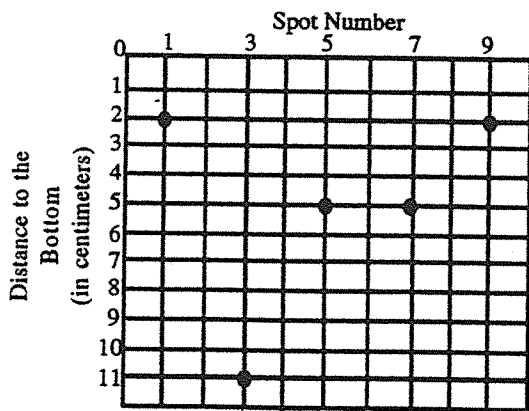
6. In the box below, make a drawing of what you think the inside bottom of the box looks like.



7. In complete sentences, explain how you determined the shape of the inside bottom of the box between the spots?

If the box's bottom is sloping, the depth of the spots in between the measured points should be gradual.

8. Below is a set of observations made on another box. Which of the drawings could represent the shape of the bottom of the box? (Circle the letters of as many choices that could be possible.)



9. Suppose you were given a measuring tool that was only 6 centimeters long. In complete sentences, explain how this would change your drawing of the inside bottom of the box?

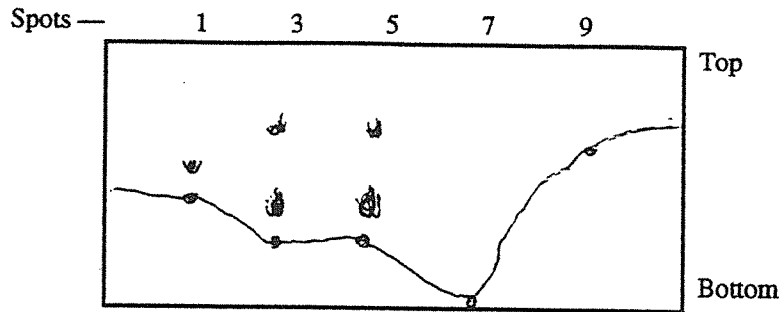
The surface of the box would seem flatter; or the data would be inconclusive, and an estimate would have to be made.

5. Based on your graph, predict the depth of the inside bottom of the box at spot 4.

8 cm  
 In complete sentences, explain the reason for your prediction in the space below.

My prediction is 8 because 3 and 5 are both at 8.

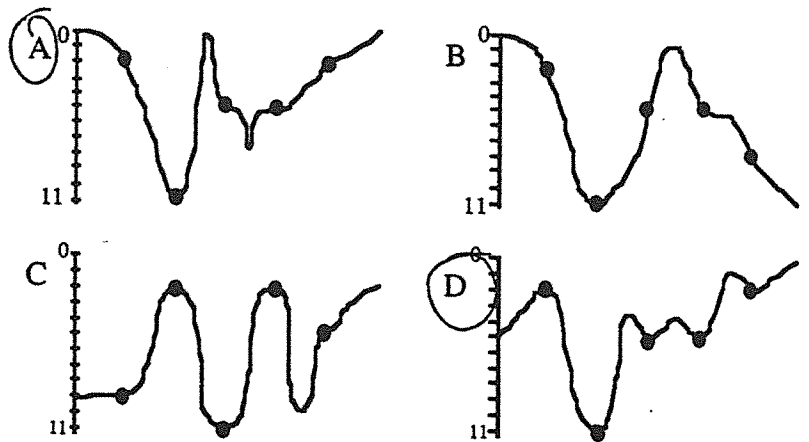
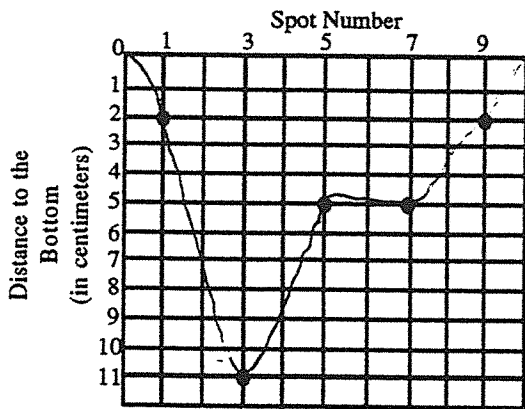
6. In the box below, make a drawing of what you think the inside bottom of the box looks like.



7. In complete sentences, explain how you determined the shape of the inside bottom of the box between the spots?

I determine the shape of bottom of box by just connecting the lines.

8. Below is a set of observations made on another box. Which of the drawings could represent the shape of the bottom of the box? (Circle the letters of as many choices that could be possible.)



9. Suppose you were given a measuring tool that was only 6 centimeters long. In complete sentences, explain how this would change your drawing of the inside bottom of the box?

I would change the drawing because there is no 11 cm on the stick, so I wouldn't have a mark at spot 3.

Student ID PUS-ES-F3 Scoring Form - Probing Under the Surface  
 Male or Female (circle One)

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. No credit
2. No credit

3. Data table

A. Recorded each correct measurement	<u>0</u>	1	2	3	4	5
B. Recorded all measurements to the nearest tenth of a centimeter	<u>0</u>	1				
C. Labeled all measurements with correct units	0	<u>1</u>				

Graph

A. Both axes correctly labeled with variables	0	<u>1</u>			
B. Appropriate scale	0	<u>1</u>			
C. Unit Given	<u>0</u>	1			
D. Points correctly plotted	0	1	<u>2</u>		
E. Line correctly drawn	0	<u>1</u>			

4. Shape Description

	0	<u>1</u>	2
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5. Estimation

A. Value of depth and units	0	1	<u>2</u>
B. Reasonable explanation	<u>0</u>	1	2

6. Model Drawing

	0	<u>1</u>	
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7. Reason for Drawing

	<u>0</u>	1	2
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8. Graph Representation

	0	<u>1</u>	2
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9. Explanation of Limited Stick

	<u>0</u>	1	2
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TOTAL SCORE 11  
 (Total possible score - 26)



# Probing Under the Surface

**Task:** At this station, you will use a measuring stick to determine the possible shape of the inside bottom of a box.

**MATERIALS:**

- 1 measuring stick
- 1 mystery box

10/25

40%

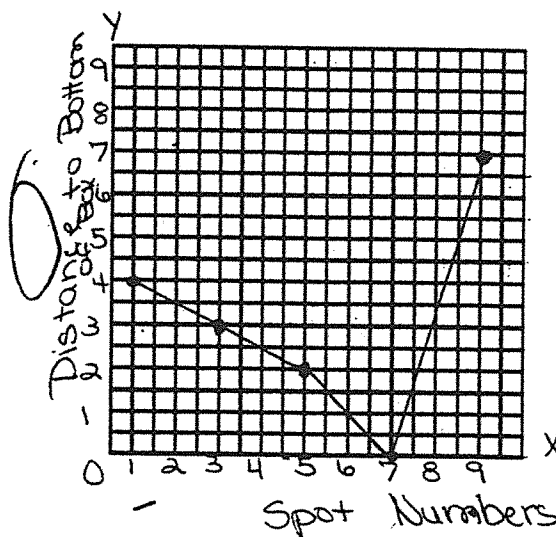
**BACKGROUND:**

Scientists and engineers use remote sensing to create an image of objects that they cannot see. To observe the shape of the ocean bottom, oceanographers use the reflection of sound waves (SONAR) or radio waves (RADAR) to "see" the ocean floor. In this activity you will use a stick as a remote sensor to indirectly observe the surface shape of the inside bottom of a mystery box that models a surface like the ocean bottom that we cannot directly observe.

**DIRECTIONS:**

1. Slide the measuring stick into each spot marked on the box lid.
2. Measure the distance to the nearest tenth of a cm from each spot to the bottom of the box.
3. Record your measurements in the data table below. Make a line graph of your data using spot number and distance to the bottom as your variables. Label both axes.

Spot Number	Distance to the Bottom of the Box
1	4cm
3	3cm
5	2cm
7	0cm
9	7cm



4. Use complete sentences to describe what your graph indicates about the shape of the bottom of the box?

The bottom of the box goes down gradually then goes steeply up.

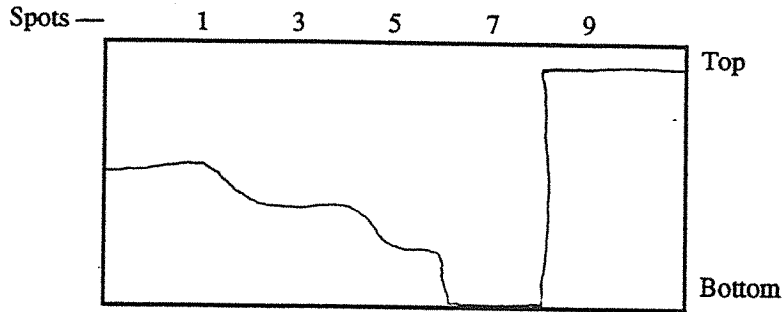
5. Based on your graph, predict the depth of the inside bottom of the box at spot 4.

I think 2.5

In complete sentences, explain the reason for your prediction in the space below.

It goes down the same as the figure it will be equal

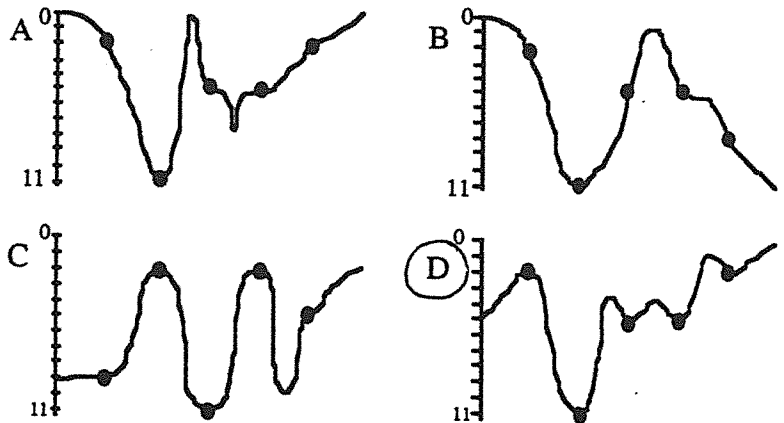
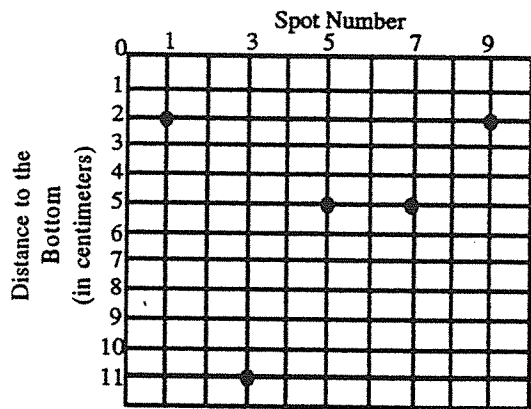
6. In the box below, make a drawing of what you think the inside bottom of the box looks like.



7. In complete sentences, explain how you determined the shape of the inside bottom of the box between the spots?

I just assumed it would go down gradually

8. Below is a set of observations made on another box. Which of the drawings could represent the shape of the bottom of the box? (Circle the letters of as many choices that could be possible.)



9. Suppose you were given a measuring tool that was only 6 centimeters long. In complete sentences, explain how this would change your drawing of the inside bottom of the box?

You would have to lower all the numbers