How Low Can You Go?

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Overview

Topic: Ocean depth.Whether you are the captain of a large sailing vessel, or a weekend fisherman, knowing the depth of the water beneath your boat is important, even critical at times. This lesson explores methods involved in mapping ocean depths, and how that information is utilized by those who navigate the oceans.

Length of Lesson

3 60-minute periods

Instructional Video/Technology

***Voyage of the Mimi #3b/6,* Mapping the Blue Part** (Extensions) World Wide Web Access

Learning Objectives

The student will be able to:
- investigate and interpret charts to obtain information
- collect and record data
- construct a bar graph with collected data
- construct a line graph with collected data
- manipulate data to obtain data in a usable form
- qualitatively measure ocean depths using various methods
- recognize that the ocean floor has varied topography

(This lesson addresses Va SOLs Math 2.21, 3.21, 4.19, 5.17, 6.18, and Science 2.1, 3.1, 4.1, 5.1, 5.2, 5.6.)

Materials

For the teacher:
- overhead of marooned ships
- plastic model of a boat
- water soluble marker
- clear plastic container
- stopwatch
- tape measure
- 2 chairs
- a piece of rope 5 feet long
- books, trash can, eraser, and various other classroom supplies
- piece of string 12 inches longer than the height of the chairs
- rock, or another heavy object
- ruler
- marking pen

Per student:
- pencil
- crayons

Per group of students:
- bathymetric map of the Gulf of Maine and Georges Bank
- chart to record leadline data and graph (attached Handout A)
- bathymetric box with wooden dowel
- graph to present data obtained from the leadline activity (attached Handout B)

- Mapping the Ocean Floor handout to collect and graph data obtained from bathymetric box (attached Handout C)

NOTE TO THE TEACHER

The bathymetric boxes will need to be constructed prior to the lesson. Using plastic shoe boxes with lids, obtainable at any dollar or discount store, create an ocean floor with varied topography using playdough, clay, or spray insulation on the bottom of each of the boxes. Drill holes in the top of the shoe box lid at one inch intervals. Each hole will be numbered beginning with the holes to the left. This is for sampling purposes. Obtain wooden dowels, or skewers with the ends cut flat, and mark every centimeter. Note: Make the drill holes large enough for the dowels to fit through. The dowels will represent the leadline. Mark off centimeter increments 0 - 12 on the dowels. The outside of the shoebox should either be painted or covered with paper as to hide the topography of the ocean floor.

Pre-Viewing Activities

1. On the overhead, show several pictures of marooned ships and vessels. Ask: What do you notice about each picture? What is wrong with each picture? Brainstorm possible causes for ships to become marooned.

2. Using a plastic model boat and a clear plastic container, float the boat in the water. Tell the children that this could be a boat in the ocean. The students are to observe the model, and explain why knowing the depth of water may be important for a sailor. Is the whole boat above water? (no) With a water soluble marker, draw the water line on the outside of the container. Trace the submerged portion of the boat. Measure how much is under the water and how much of the boat is still above the water. Since part of the boat is below the water, it is evident that a ship needs a certain amount of water to float.

3. Pass out bathymetric maps of the Gulf of Maine and Georges Bank to each group of students. What do the numbers on the chart represent? (The numbers represent the water depth in fathoms.) How do you think those numbers were collected? (Today, the ocean depth measurements are collected on oceanographic research vessels, many operated by NOOA, with depth recording instruments attached to the ships. The depth recording instruments utilize SONAR to collect measurements. They make transects across the oceans collecting data.) Why would such a chart be useful? (These charts would be necessary for anyone navigating the ocean. They allow sailors to plot their courses through known depths of ocean water to avoid any hazards such as shipwrecks or shallow depths.) Who would use such a chart? (Sailors, recreational boaters, captains, commercial fishermen, scientists) How is the chart different from other maps you have seen? (The charts indicate water depth while most maps indicate the distances between two locations.)

Focus for Viewing

To give the students a specific responsibility for viewing, say: Imagine you are the captain of a sailing vessel departing from a port on Cape Cod, Massachusetts and sailing to Georges Bank on a scientific expedition to chart whales. You have several crew members on board, and will be gone for several weeks. The video you are about to watch will provide you with information on the various methods used to measure the depths of the ocean. As the captain, you will need to pay particular attention to how measurements can be made with and without the use of modern technology.

Viewing Activities

1. START Voyage of the Mimi #3b/6 approximately 40 seconds into the video with the captain in the chart room. **Focus:** Listen carefully to discover the definition of a shoal and the destination of the Mimi. **START. STOP** tape when CT says “I know what shoals are, they’re shallow waters.” Ask: What are shoals? (Areas of shallow water) Where is the Mimi headed? (NW corner of Georges Bank).

2. REWIND the video to the same place and **FREEZE FRAME** on the charts in front of the

Captain, just before CT says "I know . . . ." Ask the students to identify symbols or features which may help us locate this area on our own charts. Several answers will include tide rips, the symbol for a shipwreck with the letters PA, the words SUBM OBSTR, and the word Georges. **STOP** the tape.

Memory Function

Most newer VCRs have a feature often referred to as "memory." If the memory function is "on," then when rewinding OR fast forwarding a tape, the tape will automatically stop at zero. If the counter is purposely reset or zeroed at a particular place in a program, the memory function can be used as a quick way to replay a segment or to cue to a different segment on the same tape.

3. If the classroom set of charts has not been passed out, distribute one chart per group. Each group is to try to locate the NW corner of Georges Bank using Cardinal directions and clues from the captain's chart on the video. It may be helpful to review cardinal directions before challenging the students to find the destination of the Mimi. Careful inspection of the charts will reveal a compass. This should be used for directional assistance.

Note to the Teacher

A four-head VCR is necessary to complete this excercise. The pause button on all others will leave white streaks and the student will not be able to make the measurements. This type of use of the video enables you to use the tape as a hands-on activity as well as for information gathering.

4. Focus: You will begin hearing many sailing terms. Listen carefully to discover what a knot is in regards to sailing. **RESUME** the video. **PAUSE** when CT asks "What's a knot Grandpa?" Ask: Who can explain what a knot is? Discuss student responses.

5. Focus: Let's see if you're right. **RESUME** the video. **STOP** when Miss Abrams says " One knot is one nautical mile per hour." Explain sailing in terms of driving a car. When driving a car, how fast you are travelling is expressed in miles per hour, but when sailing, boat speed is expressed in nautical miles per hour. Ask the students to hypothesize why nautical miles are different from miles measured on land.

NOTE TO THE TEACHER
Pause vs. Stop

When using a video interactively with students, teachers need to decide when to use **PAUSE** and when to use **STOP**. **PAUSE** the video when the anticipated discussion or activity will take less than two minutes. **STOP** for longer periods. Pausing for too long at one time can cause video heads on the VCR to become clogged which may require cleaning to correct.

6. Focus: It is very important for sailors to know the depth of the water they are sailing in. Watch carefully to discover what the numbers on nautical charts represent. **RESUME**. **PAUSE** when Albert says " That's 756 feet of moving water." Ask: What are unexploded depth charges and how did they get on the bottom of the ocean floor? (Unexploded depth charges are explosives on the bottom of the ocean. They likely arrived there during training exercises by military personnel from local military bases on Cape Cod.) What do the numbers represent near unexploded depth charges? (water depth in fathoms) How many feet are in a fathom? (6)

7. REWIND the video to the point where Miss Abrams says "One knot is one nautical mile per hour." **REPLAY** the segment, telling the students to listen carefully for the answers to the questions they have been asked. **STOP** at the same place. Again ask: What are unexploded depth charges and how did they get on the bottom of the ocean? What do the numbers represent near unexploded depth charges? How many feet are in one fathom? Discuss answers.

8. Each group is to look at their charts. Instruct the students to locate any depth charges on their charts. The students must be able to tell you how many fathoms of water lie on top of the depth charge. As a group, convert those numbers to feet of water. Ask: Why is it important for people using the ocean to know water depth near these depth charges? Discuss student responses.

9. Focus: We are now getting ready to look at some dangerous areas on the chart. I want you to be able to tell me why these areas are dangerous and how I would recognize these areas on a chart. **RESUME**. **STOP** the video when CT says "Hey, that's where we are going!" Ask: What do the round, green shaded areas on the charts represent? (shipwrecks) Look on the charts to locate areas where there have been shipwrecks. What is the water depth in the area where a student locates a shipwreck? Discuss responses. Ramone said these areas are dangerous, why? (shallow water, and shipwrecks to avoid) Is there a relationship between water depth and the location of shipwrecks? (generally, most of the shipwrecks are in shallow depths)

10. Focus: The captain cannot always rely on technology to help him sail the Mimi. Watch to discover how the captain is able to use a simple material to provide him with valuable information. **RESUME**. **PAUSE** when the captain takes the loaf of bread and Ramone is left standing with peanut butter in the galley. Ask: What does the captain take above deck with him? (a slice of bread) What does the captain think is wrong? Discuss responses. What did the captain look at before he went up on deck? (knotlog) What information does the knotlog give us? (it indicates how fast the boat is sailing)

11. REWIND and **REPLAY** the segment if the students need to see the segment again to answer the questions.

12. Ask: How do you think a piece of bread will help the captain if his equipment is not in proper working order? Discuss possible answers. **RESUME** with **SOUND OFF. PAUSE** when Rachel stops the stop watch. Ask: What are Rachel and the Captain calculating?

13. Focus: Watch closely to see if you can figure out what Rachel and the Captain are doing. **REWIND** and **REPLAY** segment with **SOUND ON. PAUSE** when the captains says "You know that trick?" Ask: Can someone explain what the Captain and Rachel were doing? (measuring how long it took the bread to travel between two points)

14. Focus: How will the Captain use that information to determine how fast the ship is moving? Watch this next segment to learn how the captain uses the information. **RESUME**. **STOP** when the captain says "Something is wrong." Ask: How fast did the captain say they were sailing? (6.5 knots) How did he calculate that? (The Captain and Rachel timed how long it look the piece of bread to travel a set distance. By dividing the distance by the time it took to travel, the Captain was able to calculate how fast they were sailing.)

15. Activity: To help demonstrate this calculation to the class, complete the following activity. With a tape measure, assign one student to measure off a section 10 feet long in the classroom. Assign another student the role of time keeper. They will operate the stop watch. Select one student to be the runner. When the time keeper says "GO", the runner will run the 10 feet, and the time keeper will time the runner for that distance. As a group, calculate how fast the runner was travelling. Ask: Who remembers how fast the knot meter said they were sailing earlier in the video? (5 knots) Why does this present a problem, having two different measurements for the speed of the Mimi? (They are heading into shallow waters where there have been many wrecks. It is important for the Captain to know exactly how fast they are sailing so he knows where they are and when to stop.) What might the problem be? Look at the evidence, what instruments on the ship are not working? (the computer and knotlog) What do they need to function? (electricity)

16. Focus: There are instruments on the ship to tell the crew the depth of the water beneath the boat. Watch to learn the name of the instrument which measures the depth of the ocean. **RESUME**. **PAUSE** when Miss Abrams says "This place is too flat, it should look more like this." Ask: What does an echosounder measure? (how deep the water is under the boat) How does the echosounder measure the depth of the water under the boat? (The echosounder sends down sound waves to the bottom and measures how long it takes them to come back up.) What part of the echosounder does not look right to Miss Abrams and why? (the flat part, it should be more wavy)

17. Focus: Watch closely to learn what the leadline is used for. **RESUME**. **PAUSE** when Rachel says" I'm measuring to see how deep the water is." Ask: What does Rachel have in her hand? (the leadline) How do you think the leadline will be used to measure how deep the water is? Discuss student responses.

18. Focus: Watch how Rachel uses the leadline to find the answer. **RESUME**. **STOP** when the Captain says "I'll get a fix with the RDM to find out." Ask: How was the leadline used to measure the depth of the water? (The leadline was thrown over, and the rope was marked in fathoms. By measuring the markings on the rope, Rachel was able to determine the depth of the water.) There is an electrical problem on board the Mimi. The instruments are misreading. The Mimi is in shallow water which is two fathoms or 12 feet deep. They may be near the shoals where there are many shipwrecks.

19. As you can see from this video, knowing the depth of the ocean is very important for sailors. Boats need water to sail. The captain uses both electrical and manual devices to measure the depth of the ocean. We will be doing several activities in which we will measure the depth of the ocean using these different methods.

Post-Viewing Activities

Day 2

1. Create a leadline activity in the classroom. Position two chairs about four feet apart with their backs facing each other. Cut a piece of rope to a length of five feet. Tie one end of the string to the back of each chair. The string should be at the same height as the chairs, and taut. Use a marking pen to mark off six inch intervals along the surface of the string. Under each mark, position books, an upturned trash can, an eraser, and various other classroom items to create stacks of varied height levels. Cut a second piece of string to be twelve inches longer than the height of the chairs. Tie a rock, or another heavy object to one end of the string. Use the marking pen to mark one inch increments along the rope, starting at the end with the weight. This rope will represent the leadline. At each six-inch interval, drop down the leadline, lowering slowly. Use the marks on the rope to determine the depth of the ocean. Count from the mark level with the taut rope, and count the marks toward the weight. The number represents the number of fathoms of water at a particular location.

2. On the chart included, record the number of fathoms for each sampling location. This is the raw data collected. Convert this data into a graphical representation. This will create a model of the ocean floor topography. Use the enclosed graph to record and graph the data. Connect neighboring points to create a continuous graph. Color the bottom portion of the graph brown to represent solid features of the ocean floor. Color the top part of the graph blue to represent the ocean.

3. Use this activity as an introduction to measuring the depth of the ocean. Ask the students what they were able to do during this activity that would not be possible if they were on the Mimi and threw the leadline over the side of the ship? (They would not be able to see the structure of the ocean floor.)

Day 3

4. Have the students use bathymetric boxes to represent an area of the ocean being studied. This box will present a situation more attune with an on-boat situation where the ocean bottom cannot be seen. Each group of students should have a copy of the attached chart. The groups will record their data on this chart. They should round to the nearest number when collecting the data. The numbers represent fathoms. Review the definition of a fathom. When all data has been collected, graph the structure of the ocean floor. Connect neighboring points. Color the bottom part of the graph brown to represent the ocean floor. Color the top portion of the graph blue to represent the ocean water.

Assessment

1. Observe each group as they collect and analyze data. Students will be assessed on their individual graphs created for each activity.

2. Students will be expected to explain the various depth measuring techniques, describe how they are utilized, and make comparisons among them.

3. An additional and optional assessment based on the students' ability level would be to evaluate sailing courses plotted on a chart for safety. They will be expected to analyze the course based on ocean depths and hazards such as unexploded depth charges and shipwrecks.

4. Students may be asked to create their own bathymetric boxes and graphically represent the ocean floor topography of their box.

Action Plan

Invite a sailor, merchant marine or weekend fisherman to the class to discuss the importance of knowing the depth of the water in which they are sailing or boating. Guests should be encouraged to describe technology which is used to assist their knowledge of water depth measurement.

Extensions

Language Arts:
- Write an invitation to the sailor, merchant marine or weekend fisherman to visit the class.
- Prepare a list of questions related to ocean depths to ask.
- Write a letter to the Sea Education Association in Woods Hole, Massachusetts requesting echo-soundings of sailing treks off Cape Cod.
- Write a letter to your local Natural Resource Conservationist requesting information on water depth measurements of lakes in your area.

Technology:
- Using the Internet, have the students visit the following web site to find satellite images of ocean depth. <www.noaa.gov>
- Using the Internet, research the use of SONAR as a method of measuring ocean depths.

Social Studies:
- Use the classroom charts to create a geography lesson surrounding where the Pilgrims landed at Plymouth Rock.
- While studying early explorers and settlers of America, use the charts to hypothesize any dangers early sailors had while sailing and landing near Plymouth Rock.

Art: Color depth profiles of the ocean into satellite images. Assign colors to ranges of numbers, for example, measurements 11-20 fathoms = red. Usually the shallowest water is orange and the darkest water is blue. Photocopies can be made of the classroom charts and then converted into a satellite image.

Research: Have the students research shipwrecks along the Atlantic Ocean. Cite cause of the shipwreck and the depth of the water where the ship wrecked.

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Leadline Ocean Depths

Sampling Site	Depth (fathoms)	Calculate Depth in Feet
A		
B		
C		
D		
E		
F		
G		
H		

Remember:
Depth in feet = depth in fathoms x 6