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Steamship *Portland*

Where Am I?

Focus
Marine navigation and position-finding

Grade Level
9-12 (Earth Science)

Focus Question
What instruments and techniques can be used for marine navigation and position-finding?

Learning Objectives
Students will be able to identify and explain at least seven different techniques that have been used for marine navigation and position finding.

Students will be able to explain the purpose of a marine sextant.

Students will be able to use an astrolabe to solve practical trigonometric problems

Materials
❒ Heavy poster board
❒ Drinking straws

Audio/Visual Materials
❒ Marker board and markers or overhead projector and transparencies for group discussions

Teaching Time
One to three 45-minute class periods, plus time for student research

Seating Arrangement
Groups of 2-4 students

Maximum Number of Students
30

Key Words
Portland Gale of 1898
Global positioning system
Astrolabe
Sextant
Longitude
Navigation

Background Information
On Thanksgiving Saturday, November 26, 1898, the passenger steamship *Portland* left Boston Harbor with 192 passengers and crew bound for Portland, Maine. The *Portland* was a state-of-the-art, luxury ship with velvet carpets, mahogany furniture, and airy staterooms. By 1898, paddlewheel steamboats had revolutionized transportation in the United States. Faster and more reliable than sailing ships, paddlewheelers could also maneuver in waters that were too shallow for sailing ships. By the 1870's, many people routinely boarded steamboats to travel between port cities. But the paddle-wheelers had a serious flaw: they were built long and narrow (the *Portland* was 281 feet long and 62 feet wide), and this shape combined with a shallow draft (the *Portland*'s keel was only 11 feet below the water line) made these ships extremely unstable in high seas. When the *Portland* steamed out of Boston Harbor, she ran straight into a monster storm moving up the Atlantic coast with northeasterly winds gusting to 90 mph, dense snow, and temperatures well below freezing. Facing a roaring northeasterly wind, the captain could not turn

back: to have done so would have placed the ship broadside to wind and waves that would surely have capsized her. The only choice was to continue to head northeast into the waves, and hope to ride out the storm. Four hours after her departure, a vessel believed to have been the *Portland* was seen near Thatcher Island, about 30 miles northeast of Boston. But the *Portland* was apparently unable to make much more progress against the storm.

At 5:45 a.m. on the morning of November 27, four short blasts on a ship's steam whistle told the keeper of the Race Point Life-Saving Station on Cape Cod that a vessel was in trouble. Seventeen hours later, life jackets, debris, and human bodies washed ashore near the the Race Point station, confirming that the *Portland* and everyone aboard had been lost in one of New England's worst maritime disasters. The loss of the *Portland* underscored the inherent instability of sidewheel paddleboats. Sidewheelers were gradually replaced by propeller-driven boats, which have a lower center of gravity.

Massive storms during late October and November are not particularly unusual in the New England states. At this time of the year, large cold air masses from Canada cross the midwestern states on a regular basis. At the same time, the Atlantic Ocean retains its summer heat and these warm waters sometimes spawn hurricanes. When the east-moving cold air masses encounter the warm, humid oceanic air the result is what New Englanders call "Nor'easters:" storms that are often severe, and are often the cause of maritime disasters.

For 90 years, the location of the *Portland* wreck was unknown, despite intense and continuing public interest. Then in April 1989, members of the Historical Maritime Group of New England found wreckage more than 300 feet deep that they were certain had been the *Portland*. Because of the depth, however, the discoverers were unable to obtain photographs or other evidence that could confirm their find. Thirteen years later, on August 29, 2002, the U.S. Commerce Department's National Oceanic and Atmospheric Administration (NOAA) confirmed that the wreck of the *Portland* had been found within NOAA's Stellwagen Bank National Marine Sanctuary. Using side-scan sonar and a remotely operated vehicle (ROV), scientists obtained high-quality video and side-scan images in a joint research mission of the Stellwagen Bank National Marine Sanctuary and the National Undersea Research Center at the University of Connecticut.

In this lesson, students will investigate tools used for navigation and position-finding, from techniques used thousands of years ago to modern GPS technology.

Learning Procedure

1. You may want to download a copy of "The *Portland* Gale" from http://www.hazegray.org for more information on the *Portland* and the monster storm of 1898. Visit http://oceanexplorer.noaa.gov for up-to-date information on the 2003 Steamship *Portland* Expedition.

2. Briefly review the story of the *Portland* and the gale of 1898. Tell students that people searched for the wreck of the *Portland* for over a hundred years, and finally found it for sure using side-scan sonar. To be most useful, this technology requires a means of precisely defining a vessel's position, so that investigators may easily return to places of interest revealed by side-scan imagery. In the search for the *Portland*, archaeologists used a differentially corrected global positioning system (DGPS) to find their position. Tell students that their assignment is to research various methods used for marine navigation and position finding, and to construct and use a simple navigation instrument.

3. Have each student group prepare a brief report that describes at least three different navigation techniques or instruments used more than 2,000 years ago, two techniques or instruments used

between 100 and 2,000 years ago, and three techniques or instruments currently in use. Have each group make a brief presentation of their research results, and tabulate the various instruments and techniques on a marker board or overhead projector transparency.

4. You may want to have your students watch the NOVA program, Lost at Sea: The Search for Longitude (available from http://www.pbs.org/wgbh/nova/novastore.html).

5. Have students construct the astrolabe described by Steven Branting of Jenifer Junior High School, Lewiston, ID (http:www.lewiston.k12.id.us/SBranting/sextant/index.html). Have each group solve the following problem using their astrolabe:

   "You are walking along a beach and see a boat drifting some distance away. A man on board yells that his engine is dead, and he needs help getting to shore. Fortunately, you have 500 feet of nylon line and are a strong swimmer. Unfortunately, you aren't sure whether 500 feet is enough to reach the boat. Fortunately, you have your trusty astrolabe and a book of trigonometric functions as well. How can you use the astrolabe to find the distance to the boat?"

   ANSWER: You mark a spot on the beach with a stick, and pace off a known distance, perpendicular to an imaginary line joining the stick with the boat (about 100 ft would be good). Then, you use your astrolabe to find the angle between the path you have just paced and the boat. From your vast knowledge of trigonometry, you know that the tangent of that angle is the distance from the stick to the boat divided by the distance you have paced. So, the distance to the boat is the distance you paced multiplied by the tangent of the angle measured with your astrolabe.

6. To wrap up, you may want to have your students do NOVA's GPS exercise (http://www.pbs.org/wgbh/nova/longitude/gps.html), and/or circumnavigation activity (http://www.pbs.org/wgbh/nova/teachers/activities/2511_longitud.html).

The BRIDGE Connection

http://www.vims.edu/bridge/archive1200.html/

The "Me" Connection

Have students write a short essay describing how their lives are affected by tools and technologies that allow for precise navigation and position-finding.

Connections to Other Subjects

English/Language Arts, Mathematics, Social Sciences

Evaluation

Written reports prepared in Step 3 and astrolabe problem is Step 5 provide opportunities for assessment.

Extensions

Log on to http://oceanexplorer.noaa.gov to keep up to date with the latest *Portland* Expedition discoveries.

Check out additional sextant activities at http:www.lewiston.k12.id.us/SBranting/sextant/index.html.

Resources

Bachelder, P. D. and M. P. Smith. 2003. Four Short Blasts. The Gale of 1898 and the Loss of the Steamer *Portland*. The Provincial Press. Portland, ME.

http://www.hazegray.org/ – Website with information on naval ships, photos, etc., and a page about the *Portland* Gale of 1898

http:www.lewiston.k12.id.us/SBranting/sextant/index.html – Steven Branting's unit on the marine sextant

http://www.pbs.org/wgbh/nova/longitude – NOVA website on the search for longitude

National Science Education Standards

Content Standard A: Science as Inquiry

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

Content Standard E: Science and Technology

- Abilities of technological design
- Understandings about science and technology

Content Standard F: Science in Personal & Social Perspectives

- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Content Standard G: History and Nature of Science

- Historical perspectives

For More Information

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