Plot the Path

Mary Anne Otten

LESSON THREE

Subject/Grade:
Grade 2, Math, Social Studies, Science

Duration:
one class period

Materials needed:
Per class:

- *Day the Great Lakes Drained Away* by Charles Ferguson Barker.
- Nautical chart – make an overhead of one page showing entry into a harbor.

Per student group:

- Cardboard shoe box (or roasting pan, plastic tub)
- Spray foam insulation, wooden blocks, egg cartons, etc.
- 12” wooden skewer
- Marker
- Ruler
- 2 cm grid paper (with x- and y-axis labeled) and additional paper to cover the top of the shoebox.
- Tape

motten@eup.k12.mi.us

Lesson Overview

Students will place a coordinate system over a model of a water body (shoe box, plastic tub) and use a wooden skewer to determine the depth at different coordinate locations. These water depth readings will tell the “ship captain” whether their ship can safely pass through without running aground or hitting a submerged obstructions which could damage the ship hull, or cause delay.

Learning Objectives

After this lesson, students will be able to

1. Plot coordinates to describe a specific location.
2. Identify potential maritime hazards: rocky shorelines, shoals, shallow water, islands, other ships.
3. Determine the safest route for a ship to follow into the harbor.
4. Compare the topography of a lake bottom to the topography of the Earth’s surface.
5. Learn new shipping vocabulary: aids to navigation, bathymetry, beacons, buoys, cartographers, charts, draft, dredging, sonar.
6. Give examples of “aids to navigation” used to protect ships, and the people and cargo they transport.

STANDARDS

Michigan Grade Level Content Expectations (GLCEs) Addressed

Math

G.1.0.02.07
Find and name locations using simple coordinate systems such as maps and first quandrant grids.

Social Studies

2-G1.0.2
Use maps to describe the spatial organization of the local community by applying concepts including relative location, and using distance, direction, and scale.

Science

S.IP.02.13
Plan and conduct simple investigations.

S.IP.02.14
Manipulate simple tools that aid observation and data collection.

S.IA.02.13
Communicate and present findings of observations.

E.SE.02.21
Describe major landforms of the surface of the Earth (mountains, plains, plateaus, valleys, hills).

Background

U. S. Aids to Navigation are "Road Signs" or markers along the waterways of the United States and its territories to assist navigation. This system employs a simple arrangement of colors, shapes, numbers and light characteristics to mark navigable channels, waterways and obstructions.

Aids to Navigation can provide a boater with the same type of information drivers get from street signs, stop signals, road barriers, detours and traffic lights. These aids may be anything from lighted structures, beacons (lighthouses), day markers, range lights, fog signals and landmarks to floating buoys. Each has a purpose and helps in determining location, getting from one place to another, or staying out of danger. The goal of the U.S. Aids to Navigation System is to promote safe navigation on the waterway.

The U.S. Aids to Navigation System is intended for use with **Nautical Charts** (maps of waterways). Charts are one of the most important tools used by boaters for planning trips and safely navigating waterways. Charts show the nature and shape of the coast, buoys and beacons, depths of water, land features, directional information, marine hazards and other pertinent information. This valuable information cannot be obtained from other sources, such as a road map or atlas.

President Thomas Jefferson recognized the value of safe, efficient marine transportation when he created the nation's first scientific agency, the Survey of the Coast in 1807. The Survey is now part of the National Oceanic and Atmospheric Administration (NOAA) whose overall mission is to support the nation's commerce with information for safe, efficient and environmentally-sound transportation. To create the nation's nautical charts, NOAA hydrographic survey ships scan the sea floor to identify navigational hazards and obstructions while also acquiring water depth data.

Bathymetry provides a detailed representation of the topography of the lake floor. Mapping the ocean or lake bottom is far more challenging than mapping on dry land, because **cartographers** (map-makers) are not able to directly observe the terrain that they are mapping. One method involves bouncing a sonar signal (sound wave) off of the ocean floor and measuring the length of time this signal takes to return.

The U.S. Aids to Navigation System includes **beacons** and **buoys**. **Beacons are aids to navigation structures that are permanently fixed to the earth's surface. They range from lighthouses to small, single-pile structures** and may be located on land or in the water. **Buoys are floating aids that come in many shapes and sizes.** They are moored to the seabed by concrete sinkers with chain or synthetic rope moorings of various lengths connected to the buoy body. They are intended to convey information to the boater by their shape or color, by the characteristics of a visible or audible signal, or a combination of two or more such features.

Advance Preparation

Each student group (or the teacher) will make a shoebox model of a lake bottom. First, the group draws a safe passage route into the harbor on the bottom of the box. Next, the students use spray insulation foam, wooden blocks, overturned egg cartons, or other objects to create obstructions to a ship's movement outside the safe passage route. The objects are randomly arranged on the bottom and taped or hot glued to the bottom to avoid objects shifting.

Next, the top of the shoebox is covered with a sheet of newsprint and secured with tape.

The 2-cm grid paper (with x- and y-axis labeled) is taped onto the paper.

When complete, the teacher distributes the shoebox models to groups of 3-4 students.

Vocabulary

Aids to Navigation – any marker along the waterways of the United States used to warn boaters and ship captains of navigational dangers.

Bathymetry – the topography of the lake or ocean bottom.

Beacons - structures that are permanently fixed to the earth's surface, such as lighthouses, to warn of navigational hazards.

Buoys – floating aids that come in many shapes, sizes, and colors representing different information to the boater.

Cartographers - map-makers

Charts - maps of waterways used by recreational boaters and ship captains

Draft - the draft of a ship's hull is the vertical distance between the waterline and the bottom of the hull (keel). Draft determines the minimum depth of water a ship or boat can safely navigate.

Dredging - often needed to keep navigation channels barrier-free and deep enough for ships to pass through. Dredging removes bottom

materials and disposes of them at a different location. Dredging disturbs aquatic ecosystems by disrupting bottom-dwelling organisms, and may expose contaminated sediments previously buried on the lake bottom.

Sonar - a technique that uses sound waves (usually underwater) to navigate, communicate or detect other vessels (SOund NAvigation and Ranging).

Procedure

1. Read *The Day the Great Lakes Drained Away* by Charles Ferguson Barker. This book shows the interesting landscape that would be revealed if all the water in the Great Lakes disappeared.

2. Display a nautical chart of the Great Lakes (NOAA #14500). Tell students that nautical charts are the "road maps" of waterways used by recreational boaters and ship captains to determine safe passage on the Great Lakes and the ocean.

3. Ask the class to brainstorm a list of landforms (mountains, hills, valleys, ridges, volcanoes, etc.). Explain that these landforms can also be found on lake and ocean bottoms, and can be obstructions to ships.

4. Ask students "What else might obstruct a ship's safe passage? Shoals, sediment, shipwrecks, etc. Show how shipping lanes into harbors are often dredged to allow safe passage. (For example, in Ontonagon, MI, the shipping lane is 17.5 feet deep and the undredged area immediately adjacent to the shipping lane is only 8 feet deep!)

5. Using a nautical chart, show students the locations of lighthouses and off-shore buoys that warn ships of shallow water or obstructions. These are called 'Aids to Navigation' and are used to warn ship captains of dangerous areas in order to protect people, ships, and the cargo they transport. Other examples are: lighthouses, fog horns, etc. Buoys serve as "traffic signals" to guide vessel operators safely along waterways (http://www.boat-ed.com/mi/handbook/toc.htm)

6. Today, we will be surveyors and measure the depth of the water to find a safe route into the harbor. Students will work in groups. Each group will be given a shoebox or "lake" prepared by another student group or the teacher (see Advanced Preparation). Students will name their lake, and name the vessel that they will navigate across the "lake." Students will draw a colored line on their skewer to indicate safe water depth for their ship to safely move through the water. A safe depth is when the skewer reaches all the way to the bottom.

7. Whenever the skewer hits an obstacle, the water is too shallow. Circle that coordinate point red on the grid paper for STOP! Shipping lanes must be at least 2"wide to allow the ship through. If the skewer reaches to the bottom with no obstruction, circle that coordinate point green for GO! Students take turns moving the skewer and checking for water depth, as they move from coordinate to coordinate on the paper.

8. Once they have determined their route, have students remove the paper to see if they identified the best route into the harbor.

Assessment of Student Learning

Have students present their lake to the class and show their route of "safe" passage into the harbor.

Extensions

Make a bathymetric map of the entire shoebox, noting the water depth at every coordinate.

References

Maritime Heritage Educational Resource Guide: Great Lakes Lighthouse Keepers Association. 1998.

NOAA Great Lakes map #14500

U.S. Aids to Navigation: http://www.uscgboating.org/safety/aton/system.htm

National Oceanic & Atmospheric Administration http://www.noaa.gov/charts.html and http://www.history.noaa.gov/

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