

**Thunder Bay 2010:  
Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships**

# Do You Have a Sinking Feeling?

(adapted from the Aegean and Black Sea 2006 Expedition)

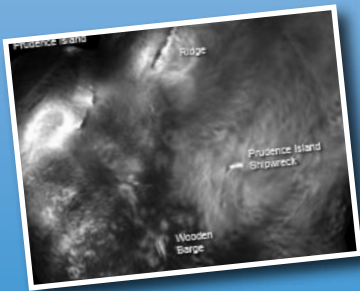


Image captions/credits on Page 2.

# lesson plan

## Focus

Marine archaeology

## Grade Level

9-12 (Earth Science/Mathematics)

## Focus Question

How can marine archaeologists use historical and archaeological data to draw inferences about shipwrecks?

## Learning Objectives

- Students will plot the position of a vessel given two bearings from the vessel on appropriate landmarks.
- Students will draw inferences about a shipwreck given information on the location and characteristics of artifacts from the wreck.
- Students will explain how the debris field associated with a shipwreck gives clues about the circumstances of the vessel's sinking.

## Materials

- Copies of *Last Entries from the Logbook of the Sloop Gilbert Demont*, *Grid Reference System for Unidentified Shipwreck Q11WRK5*, and *List of Artifacts Retrieved from Unidentified Shipwreck Q11WRK5*, one copy for each student group
- Copies of *Nautical Chart of Middle Island and Rockport*, one copy for each student group (see Learning Procedure)

## Audio-Visual Materials

- Marker board and markers or overhead projector and transparencies for group discussions

## Teaching Time

One or two 45-minute class periods

## Seating Arrangement

Groups of 2-4 students

## Maximum Number of Students

32

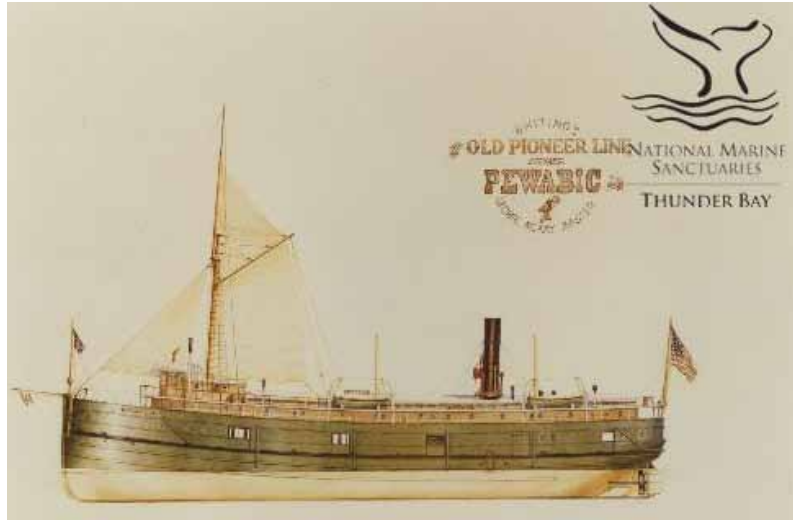
## Key Words

Lake Huron  
Shipwreck

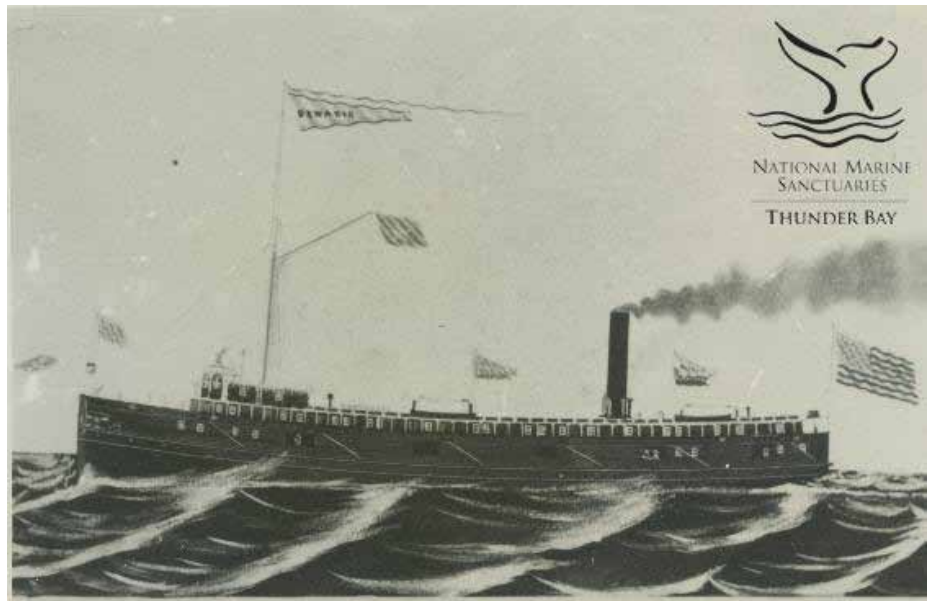
Marine archaeology  
Debris field  
Artifact

### Background Information

*NOTE: Explanations and procedures in this lesson are written at a level appropriate to professional educators. In presenting and discussing this material with students, educators may need to adapt the language and instructional approach to styles that are best suited to specific student groups.*



Above and below: The *Pewabic*. Image courtesy Thunder Bay National Marine Sanctuary. <http://www.greatlakesships.org/vesselview.aspx?id=112129> Check out the Alpena County George N. Fletcher Public Library: <http://www.alpenalibrary.org/special/tbrc/tbrc.html>



August 9, 1865 – Early this evening in one of the Great Lakes' worst maritime disasters, the steamship *Pewabic* collided bow-to-bow with her sister ship *Meteor* and quickly sank, taking 125 passengers and crew to a watery grave 180 feet below the surface of Lake Huron. Nicknamed the "Greyhound of the Lakes," because she could achieve

#### Images from Page 1 top to bottom:

Existing (yellow) and proposed (green) boundaries of the Thunder Bay National Marine Sanctuary. Locations of some known shipwrecks are indicated. Source: Thunder Bay National Marine Sanctuary

A crew in a support boat releases the line from the Naval Undersea Warfare Center (NUWC) REMUS 600 unmanned underwater vehicle equipped with the Integrated Precision Underwater Mapping (iPUMA) subsystem in Narragansett Bay during the Autonomous Vehicle Fest in May 2008.

<http://www.militaryaerospace.com/index/display/article-display/337291/articles/military-aerospace-electronics/volume-19/issue-8/features/special-report/swimming-robots.html>

This image was captured by iPUMA, a wide-swath forward-looking sonar used to identify possible targets. Here we see the two wrecks off Prudence Island, as well as features on the surrounding seafloor. To get a sense of scale, consider that the wooden barge is 120 feet long.

[http://oceanexplorer.noaa.gov/explorations/08auvfest/logs/summary/media/ipumas2\\_3\\_sonar.html](http://oceanexplorer.noaa.gov/explorations/08auvfest/logs/summary/media/ipumas2_3_sonar.html)

Once a shipwreck has been located on a sonar image, archaeologists don SCUBA gear to "ground truth" the discovery. Dives deeper than about 40 m require the use of special breathing mixtures containing helium, oxygen, and nitrogen to reduce some of the safety hazards that accompany breathing ordinary air during deep dives. Source: Thunder Bay National Marine Sanctuary

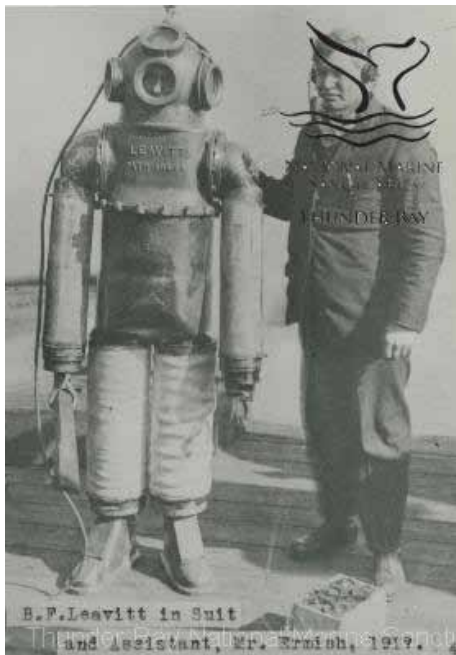
Map 1. Great Lakes region, with Thunder Bay National Marine Sanctuary marked with a red dot.



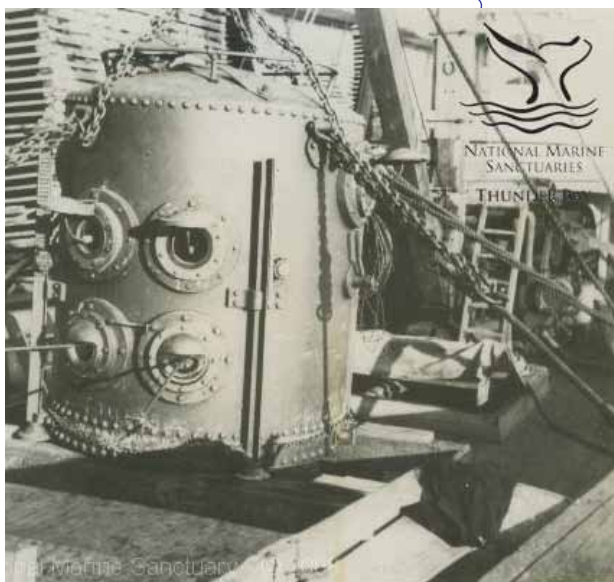
US Army Corps of Engineers, Detroit District. From Wikipedia.

Figure 1. Existing (yellow) and proposed (green) boundaries of the Thunder Bay National Marine Sanctuary. Locations of some known shipwrecks are indicated. Source: Thunder Bay National Marine Sanctuary





Diving armor used in salvage  
Image credit: Fred Trelfa, National Marine Sanctuaries Foundation  
<http://www.greatlakesships.org/vesselview.aspx?id=112129>



Smith Diving Bell used in salvage  
Image credit: Fred Trelfa, National Marine Sanctuaries Foundation  
<http://www.greatlakesships.org/vesselview.aspx?id=112129>

a top speed of 12 knots, *Pewabic* was one of the most elegant ships of her day. Passengers enjoyed stained glass windows, skylights, satin draperies, marble tabletops, rosewood furniture, and silver tableware. In addition to passengers, *Pewabic* also carried package freight. When she left Sault Sainte Marie on August 9, the ship's cargo included a large quantity of copper from Michigan's mines, and (according to some rumors) may also have included 18 kegs of silver.

Rumors of copper and silver were more than enough incentive for treasure hunters to risk their lives in a series of attempts to salvage the precious metals. Long before the invention of SCUBA and long before the hazards of breathing air under pressure were understood, these attempts were extremely dangerous. Within weeks of *Pewabic's* sinking, Billy Pike stepped into a hard-hat diving suit and made the first attempt to retrieve treasure from the ship. The attempt failed and Pike died. In 1891, Oliver Pelkey successfully descended to the shipwreck using an improved diving suit. The suit collapsed on the second dive, killing Pelkey. Six years later, the American Wrecking and Salvage Co. retrieved fifty tons of copper from the wreck. Encouraged by this success, George Campbell and Peter Olson descended in an experimental diving bell in 1898. Both men drowned when the glass porthole shattered. Some subsequently salvage attempts were more successful, but the string of deaths coupled with stories of skeletons in the cabins and other spooky rumors earned *Pewabic* a new nickname: Lake Huron's Death Ship.

The story of the *Pewabic* is only one of more than 200 tales of ships that have ended their days in Lake Huron. The second largest of the Great Lakes and the third largest in the world, Lake Huron is notorious for its dense fog banks, violent storms, and rocky shoreline. The area surrounding Thunder Bay is so hazardous to shipping that it has earned the nickname Shipwreck Alley, and now represents one of the nation's most historically significant collections of shipwrecks. The Thunder Bay National Marine Sanctuary (TBNMS) was established in 2000 to protect this important cultural resource. The present boundaries of the TBNMS enclose 448 square miles that contain 40 known historic shipwrecks. Plans are well underway, however, to expand these boundaries to include 3,662 square miles (Figure 1). Archival records indicate that the expanded boundaries include more than 100 undiscovered shipwrecks which can provide unique opportunities for historians and archaeologists to study the maritime and cultural history of the Great Lakes region, as well as for recreational explorers. Finding the exact location of these shipwrecks is obviously essential to these kinds of uses, as well as to protecting these resources.

To help meet this need, in 2008 a remote sensing survey was undertaken in the northern portion of the proposed expansion area. This survey used a side scan sonar towed from a research vessel, as well as a conventional sonar system mounted on an autonomous underwater vehicle (AUV). The 2008 survey covered an area of about 100 square miles and located two new shipwrecks. The total proposed expansion area is much larger, though, so a third survey strategy is needed to efficiently cover large areas of deep water. As its name suggests, the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships Expedition will use state-of-the-art technology that includes a sophisticated AUV carrying a one-of-a-kind precision sonar system to survey up to 200 square nautical miles in the proposed expansion area. Further investigation of shipwrecks located during the survey will be done by marine archaeologists using technical diving procedures. If particularly interesting wrecks are discovered, these "ground truthing" dives may be done during the Thunder Bay 2010 Expedition. Most of these investigations, however, will be done after the expedition's conclusion.

In this lesson, students will analyze historical and archaeological data to draw inferences about shipwrecks.

### Learning Procedure

1. To prepare for this lesson:
  - (a) Review introductory essays for the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships Expedition at <http://oceanexplorer.noaa.gov/10thunderbay/welcome.html>
  - (b) Review Steps 2 through 5, below.
2. Briefly introduce students to "Shipwreck Alley" and the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships Expedition. Tell students that they are going to assume the roles of consulting marine archaeologists investigating shipwrecks, and that they have two assignments. The first is to locate the probable site of a ship that sank many years ago. The second is to use artifacts collected from an unidentified wreck to answer questions about the age of the vessel, its purpose, who was aboard, and why it sank.
3. Distribute one copy of *Nautical Chart of Middle Island and Rockport* and one copy of *Last Entries from the Logbook of the Sloop Demont Gilbert* to each student group. Explain that the *Demont Gilbert* was a trading sloop that was lost in the early 1900's somewhere near Rockport, Michigan on Lake Huron during a violent November gale. Though wreck of the ship was never found, we have the extraordinary good fortune to have discovered the ship's log in an antique shop. Apparently, the

logbook mysteriously came ashore and was picked up by a young boy walking along the beach after the storm. The boy decided it wasn't very interesting, tossed it into an old chest, and promptly forgot about it. Over the following years, the boy grew up, lived a long life, and finally died. His son discovered the old chest while he was cleaning out his father's house, but didn't pay any attention to the contents. The chest was sold to an antique dealer along with many other items. Yesterday, one of our marine archaeologist colleagues happened into the antique dealer's store, spotted the old logbook, and realized what he had found. Today, we will try to pinpoint the probable site of the wreck of the *Demont Gilbert*!

Have students plot the last five entries from the *Gilbert's* logbook using protractors. Assume that the longitude lines on the chart indicate true North, that bearings are true (i.e., not affected by magnetic variation or compass deviation), and that major landmarks used for coastwise navigation have not changed since the time of the *Gilbert*. Students will have to decipher the captain's abbreviations. If they need help, "MILT" probably stands for Middle Island Light, "FP" is probably Ferron Point, and "RPLite" could very well be the light at the end of the jetty in Rockport. The skipper was clearly in a hurry, since it is customary to use three bearings to establish a position or "fix," but, if he was careful, his notes may still be helpful. Tell students that local weather records show that the wind was blowing at 60 mph out of the east at the time these entries were made in the *Gilbert's* log.

When students have completed charting the five positions, ask each group to speculate on what happened to the *Gilbert* and where her wreck might be. Figure 1 (at the end of this lesson) shows the ten bearings from the logbook, and their corresponding positions within the harbor. Since the wind was blowing from the east, the *Gilbert* was probably being driven toward the rocky shore. Being a sailing vessel, it would have been extremely difficult to sail away from the shore, since that would have meant sailing almost directly into the wind. Perhaps the skipper hoped to be able to find shelter in the sliver of deep water west of Middle Island. Alas, his ship was dismasted when she was almost due east of Rockport, and the *Gilbert* was driven onto the rock by the strong easterly wind. Wreckage from the *Gilbert* probably lies somewhere along the coast near Rockport. We can't be confident of a specific location for the wreck of the *Demont Gilbert*; but we have narrowed our search area!

4. Distribute one copy of *Grid Reference System for Unidentified Shipwreck Q11WRK5* and one copy of *List of Artifacts Retrieved from Unidentified Shipwreck Q11WRK5* to each student group. Explain that a grid system is often used in archaeological investigations to prepare a precise record of a debris field and to document the exact location of artifacts and their relationship to each other (you

may want to remind students that they have used grids to express location if they have ever played Battleship, or even Bingo). Have students prepare a brief report, summarizing their interpretation of the artifacts, with specific reference to clues about:

- the specific identity of the wreck;
- age of the vessel;
- the vessel's purpose;
- who was aboard; and
- why the vessel sank.

If students have trouble approaching this problem, suggest that they organize the artifacts by location, including depth below the surface, then consider what the artifacts may suggest with regard to the above questions.

Have each student group make an oral presentation of their conclusions, summarizing their inferences on a marker board or overhead transparency. Lead a discussion of these results.

The ship was approximately 200 feet long with a beam of 31 feet, and a hull that was about 2 feet thick. Propellers and a smokestack indicate that this was a steam powered vessel. This was a large, powerful ship and was probably well-known during its day.

Artifacts in quadrats D10, D13, and G10 suggest that men, women, and children may have been aboard, and these areas may have been staterooms. The fact that artifacts in these areas were close to the surface suggests that these staterooms were on or near the deck of the vessel. Eating utensils recovered from more than 2m below the surface suggest a dining area, located on a lower deck. Engraved silver flatware and the carved wooden plank are valuable clues, suggesting that the name of the vessel may have begun with the letter "P" and ended with the letters "bic." Many of the artifacts suggest wealth and luxury. This vessel almost certainly carried some wealthy passengers. Remnants of a Union Army uniform suggest that there were also soldiers aboard, and might help date the vessel.

Encourage students to think about the size of the debris field. Ships that sink suddenly (such as those sunk in battle) often have a rather small debris field. Ships that sink with lots of movement, on the other hand (such as ships sunk in storms) are likely to have larger debris fields. This ship has a rather compact debris field, suggesting that she sank relatively rapidly. The absence of an upper deck suggests some sort of explosion or violent event that removed this structure. A storm might be one possibility, but this explanation conflicts with the relatively compact debris field. The hull damage on the port side suggests a collision, since hull timbers appear to have been driven inward.

5. Briefly review the story of the *Pewabic* (see Background Information). Students will probably realize that the “unidentified wreck” has been modeled after the *Pewabic*, which did have a dining salon on a lower deck, and staterooms on deck around the edge of the ship. The large wood arch was built into long wooden ships to add strength in the middle of the vessel. When the *Pewabic* was intact, the arch was hidden in the center of the ship. This feature made *Pewabic* lighter as well as making it easier to load cargo.



Illustration of the *Pewabic* shipwreck; note the strengthening arch along the midline of the ship. Credit: Thunder Bay National Marine Sanctuary. <http://www.greatlakesships.org/vesselview.aspx?id=112129>; and Alpena County George N. Fletcher Public Library: <http://www.alpenalibrary.org/special/tbrc/tbrc.html>

Stained-glass windows, rosewood furniture, and silver serving ware were part of the luxurious setting aboard the *Pewabic*. The stringed instrument was probably part of the string orchestra that provided entertainment on the promenade deck. Michigan was the first major copper mining region in the United States, and copper was shipped on the Great Lakes to many other parts of the country. The copper ingot was probably overlooked by salvors who recovered most of *Pewabic's* copper cargo. The explanation for the missing upper deck is that air was trapped in the hull, and because the ship sank so quickly, the trapped air blew off the top deck and cabins. When the ship crashed onto the bottom, the bow was shoved back into the hull.

While the artifacts activity is based on some of the known facts about the *Pewabic* and her sinking, the wreck of the *Demont Gilbert* is entirely fictitious. Demont Gilbert was, however, captain of the *Pewabic* on her final voyage.



**The BRIDGE Connection**

[www.vims.edu/bridge/archive1200.html/](http://www.vims.edu/bridge/archive1200.html/) – Links to information about shipwrecks and marine archaeology.

**The “Me” Connection**

Have students write a short essay explaining why exploring for Great Lakes shipwrecks is, or is not, important.

**Connections to Other Subjects**

English/Language Arts

**Assessment**

Charts and written reports prepared in Steps 3 and 4 provide opportunities for assessment.

**Extensions**

1. Have students visit <http://oceanexplorer.noaa.gov/10thunderbay/welcome.html> to keep up with the latest discoveries from the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron’s Lost Ships Expedition.
2. Visit the Ocean Explorer Web site for the PHAEDRA 2006 Expedition (<http://oceanexplorer.noaa.gov/explorations/06greece/>) for more information about explorations to learn more about ancient seafaring cultures.

**Other Relevant Lesson Plans from NOAA’s Office of Ocean Exploration and Research**

**The Robot Archaeologist**

(17 pages, 518k) (from AUVfest 2008)

<http://oceanexplorer.noaa.gov/explorations/08auvfest/background/edu/media/robot.pdf>

Focus: Marine Archaeology/Marine Navigation (Earth Science/Mathematics)

In this activity, students will design an archaeological survey strategy for an autonomous underwater vehicle (AUV); calculate expected position of the AUV based on speed and direction of travel; and calculate course correction required to compensate for the set and drift of currents.

**Where Am I?**

(7 pages, 264 kb) (from the 2003 Steamship Portland Expedition)

<http://oceanexplorer.noaa.gov/explorations/03portland/background/edu/media/portlandwhereami.pdf>

Focus: Marine navigation and position-finding

In this activity students will be able to identify and explain at least seven different techniques that have been used for marine navigation and position finding, explain the purpose of a marine sextant, and use an astrolabe to solve practical trigonometric problems.

**By Land or By Sea or Both?**

(14 pages, 1.1 Mb) (from the Exploring the Submerged New World 2009 Expedition)

<http://oceanexplorer.noaa.gov/explorations/09newworld/background/edu/media/landsea.pdf>

Focus: Watercraft in Paleoamerican Migrations

In this activity, students will describe evidence that supports the idea that the initial settlement of North and South America involved watercraft, discuss types of watercraft that might have been involved in new world settlement, and explain at least three advantages and three disadvantages of coastal settlements compared to inland settlements.

**The Ridge Exploring Robot**

(27 pages, 1.6 mb) (from the INSPIRE: Chile Margin 2010 expedition)

<http://oceanexplorer.noaa.gov/explorations/10chile/background/edu/media/robot.pdf>

Focus: Autonomous Underwater Vehicles/Marine Navigation

Students will explain a three-phase strategy that uses an autonomous underwater vehicle (AUV) to locate, map, and photograph previously undiscovered hydrothermal vents, design a survey program to provide a photomosaic of a hypothetical hydrothermal vent field, and calculate the expected position of the AUV based on speed and direction of travel.

**X-Storms**

(5 pages, 384k) (from the 2003 Steamship Portland Expedition)

<http://oceanexplorer.noaa.gov/explorations/03portland/background/edu/media/portlandstorm.pdf>

Focus: Extreme storms (Earth Science)

In this activity, students identify and explain three factors that contributed to extreme storm conditions during the Halloween Nor'easter of 1991, discover how to obtain real-time and historical meteorological data, and compare and contrast extra-tropical cyclones, tropical cyclones, and hybrid storms.

### Now Take a Deep Breath

(14 pages, 548 Kb) (from the Exploring the Submerged New World 2009 Expedition)

<http://oceanexplorer.noaa.gov/explorations/09newworld/background/edu/media/breath.pdf>

Focus: Physics and physiology of SCUBA diving (Physical Science/Life Science)

In this activity, students will be able to define Henry's Law, Boyle's Law, and Dalton's Law of Partial Pressures, and explain their relevance to SCUBA diving; discuss the causes of air embolism, decompression sickness, nitrogen narcosis, and oxygen toxicity in SCUBA divers; and explain the advantages of gas mixtures such as Nitrox and Trimix and closed-circuit rebreather systems.

### Other Resources

*The Web links below are provided for informational purposes only. Links outside of Ocean Explorer have been checked at the time of this page's publication, but the linking sites may become outdated or non-operational over time.*

<http://oceanexplorer.noaa.gov/10thunderbay/welcome.html> – Web site for the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships Expedition

<http://celebrating200years.noaa.gov/edufun/book/welcome.html#book> – A free printable book for home and school use introduced in 2004 to celebrate the 200th anniversary of NOAA; nearly 200 pages of lessons focusing on the exploration, understanding, and protection of Earth as a whole system

<http://thunderbay.noaa.gov/welcome.html> – Web site for the Thunder Bay National Marine Sanctuary with links to Lesson Plans; includes grades K - 2 Boat Builder Activity, grades 3 - 5 Photomosaic Activity, grades 3 - 5 Mapping Activity, grades 6+ Mapping Activities, Steamships and Energy Conversions, and Make Your Own Putt-Putt Boat

<http://www.greatlakesships.org/> – Great Lakes ships database from Thunder Bay National Marine Sanctuary at the Alpena County George N. Fletcher Public Library

### 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

**Content Standard F: Science in Personal and Social Perspectives**

- Natural hazards
- Science and technology in society

**Ocean Literacy Essential Principles and Fundamental Concepts**

**Essential Principle 6.**

**The ocean and humans are inextricably interconnected.**

*Fundamental Concept d.* Much of the world’s population lives in coastal areas.

*Fundamental Concept f.* Coastal regions are susceptible to natural hazards (such as tsunamis, hurricanes, cyclones, sea level change, and storm surges).

**Essential Principle 7.**

**The ocean is largely unexplored.**

*Fundamental Concept a.* The ocean is the last and largest unexplored place on Earth—less than 5% of it has been explored. This is the great frontier for the next generation’s explorers and researchers, where they will find great opportunities for inquiry and investigation.

*Fundamental Concept b.* Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.

*Fundamental Concept d.* New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

**Send Us Your Feedback**

We value your feedback on this lesson.

Please send your comments to: [oceanexeducation@noaa.gov](mailto:oceanexeducation@noaa.gov)

**For More Information**

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## Student Handout

### Last Entries from the Logbook of the Sloop Demont Gilbert

11/27/06, 6:10 pm - MILT bears 214, FP bears 266

11/27/06, 6:30 pm - MILT bears 180, FP bears 262

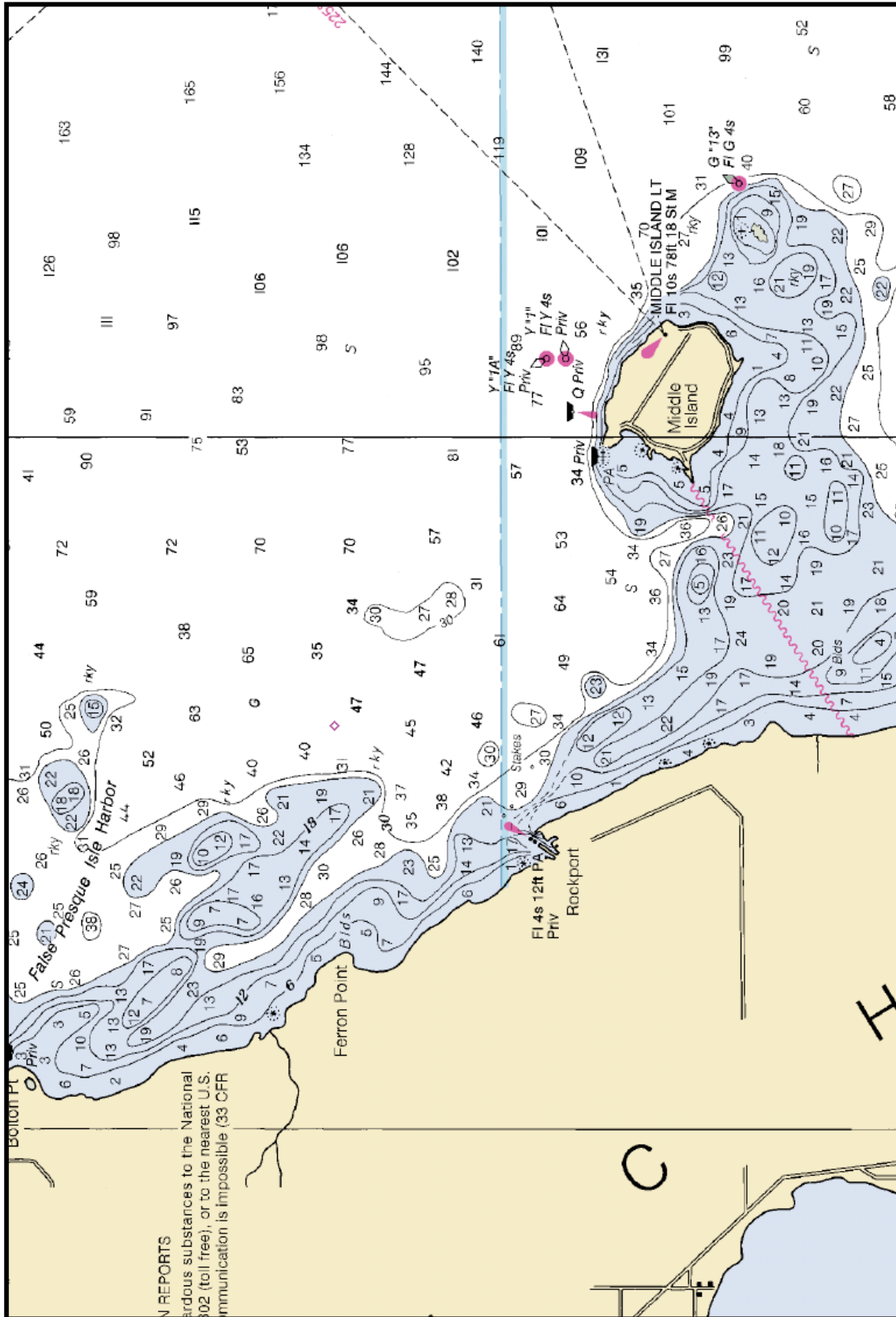
11/27/06, 6:55 pm - MILT bears 150, RPLite bears 216

11/27/06, 7:15 pm - FP bears 285, RPLite bears 258

11/27/06, 7:35 pm - Dismasted! FP bears 305, RPLite bears 273

*Have mercy on our souls...*

### Nautical Chart of Middle Island and Rockport



## Student Handout

### List of Artifacts Retrieved from Unidentified Shipwreck Q11WRK5

Grid Reference	Description
C6–C19	Large wood arch, supported along centerline
D10	Gentleman's gold ring, 55 cm from surface
E14	Heavy rosewood chair, velvet upholstery, 3 m from surface
D10	China plate, 2.5 m from surface
G10	China chamber pot, 50 cm from surface
D13	Silver flatware, engraved letter "P," 2.5 m from surface
F14	China cup, 2.5 m from surface
D10	Brandy flask, 50 cm from surface
E14	Stained glass skylight, 40 cm from surface
D13	Carved mahogany headboard, 70 cm from surface
B13	Stringed musical instrument (cello?), 25 cm from surface
D10	Button, brass, Union Army, 2.5 m from surface
D13	Lady's dress shoe, 65 cm from surface
B10	Shaving straight razor, 55 cm from surface
D17	Silver buckle, 70 cm from surface
D13	China chamber pot, 60 cm from surface
C11	Carving knife, 2.3 m from surface
D10	Man's leather dress shoe, 60 cm from surface
B3	Carved wooden plank, letters "BIC;" left side broken
C11	Silver serving platter, 2.3 m from surface
E2	Rusted iron mass, possibly chain
E21	Heavily rusted iron mass, possibly tools, 2.5 m from surface
D10	Small mahogany chest of drawers, 70 cm from surface
C17	Small copper ingot, partially buried
B22, D22	Metal propeller, approx 8 ft diameter, partially buried
E17	Smokestack

NOTE: Most debris is close to main wreck; few remnants of what may have been an upper deck; bow appears to have been forced backward into hull; timbers of hull approximately 2 feet thick; hull severely damaged on port side near grid cells A7-A8; hull timbers appear to have been forced inward

### Student Handout

## Grid Reference System for Unidentified Shipwreck Q11WRK5

