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Deepwater Coral Expedition: Reefs, Rigs and Wrecks

Marine Archaeology
(adapted from the 2003 Steamship *Portland* Expedition)

Focus
Marine Archaeology

Grade Level
5-6 (Physical Science)

Focus Question
How can marine archaeologists use archaeological data to draw inferences about shipwrecks?

Learning Objectives
Students will be able to draw inferences about a shipwreck given information on the location and characteristics of artifacts from the wreck.

Students will be able to explain how the debris field associated with a shipwreck gives clues about the circumstances of the vessel's sinking.

Materials
❒ Copies of "Grid Reference System for Unidentified Shipwreck Q11WRK5," and "List of Artifacts Retrieved from Unidentified Shipwreck Q11WRK5," one copy for each student group

Audio/Visual Materials
None

Teaching Time
One or two 45-minute class periods

Seating Arrangement
Groups of three to four students

Maximum Number of Students
32

Key Words
Gulf of Mexico
Deepwater coral
Shipwreck
Debris field
Artifact

Background Information
In recent years, rising costs of energy and a growing desire to reduce the United States' dependence upon foreign petroleum fuels have led to intensified efforts to find more crude oil and drill more wells in the Gulf of Mexico. This region produces more petroleum than any other area of the United States, even though its proven reserves are less than those in Alaska and Texas. Managing exploration and development of mineral resources on the nation's outer continental shelf is the responsibility of the U.S. Department of the Interior's Minerals Management Service (MMS). Besides managing the revenues from mineral resources, an integral part of the Deepwater Corals Expedition: Reefs, Rigs and Wrecks mission is to protect unique and sensitive environments where these resources are found.

To locate new sources of hydrocarbon fuels, MMS has conducted a series of seismic surveys to map areas between the edge of the continental shelf and the deepest portions of the Gulf of Mexico. These maps provide information about the depth of the water as well as the type of material that is found on the seafloor. Hard surfaces are often found where hydrocarbons are present. Carbonate rocks (such as limestone), in particular, are a part of nearly every site where fluids and gases containing hydrocarbons have been located. This is because when microorganisms consume hydrocarbons under anaerobic conditions, they produce bicarbonate which reacts with calcium and magnesium ions in the water and precipitates as carbonate rock. This rock, in turn, provides a substrate where the larvae of many other deep sea bottom-dwelling organisms may attach, particularly corals. In addition to carbonate rocks associated with hydrocarbon seeps, deepwater corals in the Gulf of Mexico are also found on anthropogenic (human-made) structures, particularly ship wrecks and oil platforms.

Deepwater coral reefs were discovered in the Gulf of Mexico nearly 50 years ago, but very little is known about the ecology of these communities or the basic biology of the corals that produce them. Recent studies suggest that deepwater reef ecosystems may have a diversity of species comparable to that of coral reefs in shallow waters, and have found deepwater coral species on continental margins worldwide. One of the most conspicuous differences between shallow- and deepwater corals is that most shallow-water species have symbiotic algae (zooxanthellae) living inside the coral tissue, and these algae play an important part in reef-building and biological productivity. Deepwater corals do not contain symbiotic algae (so these corals are termed "azooxanthellate"). Yet, there are just as many species of deepwater corals (slightly more, in fact) as there are species of shallow-water corals. Deepwater reefs provide habitats for a variety of plant, animal, and microbial species, some of which have not been found anywhere else. Branching corals and other sessile (non-motile) benthic (bottom-dwelling) species with complex shapes provide essential habitat for other organisms including commercially-important fishes such as longfin hake, wreckfish, blackbelly rosefish, and grenadiers. In addition, recent research has shown that less obvious, obscure benthic species may contain powerful drugs that directly benefit humans.

The long-term goal of the Deepwater Coral Expedition: Reefs, Rigs, and Wrecks is to develop the ability to recognize areas where deepwater corals are "likely to occur" in the Gulf of Mexico. Achieving this goal involves three objectives:

- Discover and describe new locations in the deep (greater than 300m depth) Gulf of Mexico where there are extensive coral communities;
- Gain a better understanding of the processes that control the occurrence and distribution of deepwater coral communities in the Gulf of Mexico; and
- Study the relationships between coral communities on artificial and natural substrates with respect to species composition and function, genetics, and growth rates of key species.

Because shipwrecks are a potential substrate for deep-water coral communities, these objectives include both biological and archeological questions. Three of the key archeological questions are:

- What is the identity, type of ship, date of construction, nationality, past and present ownership, use history, cause of loss, mission, and cargo at time of loss of each vessel?
- What is the extent and condition of the artifact assemblage and the presence of diagnostic artifacts on each vessel?
- Are any of these vessels potentially eligible to the National Register of Historic Places?

Learning Procedure

1. To prepare for this lesson, review introductory essays for the Deepwater Coral Expedition: Reefs, Rigs, and Wrecks at http://oceanexplorer.noaa.gov/explorations/08lophelia/welcome.html.

You may also want to visit http://www.bio.psu.edu/cold_seeps for a virtual tour of a cold seep community in the Gulf of Mexico, and http://oceanexplorer.noaa.gov/gallery/livingocean/livingocean_coral.html for images of deep-sea corals and their communities.

You may also 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/explorations/03portland/welcome.html for more information about the 2003 Steamship *Portland* Expedition.

2. Briefly introduce the Deepwater Coral Expedition: Reefs, Rigs, and Wrecks and describe deepwater coral communities. You may want to show images from http://oceanexplorer.noaa.gov/gallery/livingocean/livingocean_coral.html. Emphasize the importance of suitable substrates to the development of these communities, pointing out that both natural and human-made substrates may be suitable for coral larvae settlement. Ask students what types of artificial substrates might be found in the deep Gulf of Mexico. Shipwrecks should be among the possibilities. Say that the Deepwater Coral Expedition will visit at least six deep-water shipwrecks, and the identity of some of these ships is not known. Tell students that one of the objectives of the expedition is to find out as much as possible about the identity, history, and cause of sinking of each vessel.

   Tell students that they are going to assume the role of consulting marine archaeologists investigating shipwrecks, and that they have been hired 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 "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
   - 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.

4. 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 large paddlewheels near the middle of the ship clearly suggest a sidewheel paddleboat. This was a large vessel for a paddlewheeler; over 280 feet. The diamond shaped metal structure is probably the remains of a walking beam engine, a common design in ships of this type. The fact that this was a large paddlewheeler narrows its probable vintage to between 1890 and 1910. 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 sur-

face 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 "rtland." Many of the artifacts suggest wealth and luxury. This vessel almost certainly carried some wealthy passengers.

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 an extensive debris field, suggesting that a lot of motion, possibly due to a storm, was involved in her sinking.

5. Briefly review "The Story of the Steamship *Portland* and the Gale of 1898." Students will probably realize that the "unidentified wreck" has been modeled after the *Portland*. The *Portland* did have a dining salon on a lower deck forward of the engines, and staterooms on deck around the edge of the ship. Evidence collected during explorations of 2002 suggests that the entire superstructure of the ship may have been swept away by a huge wave, leaving the hull to fill and sink. For purposes of this activity, the mystery wreck has been allowed to keep the forward portion of her superstructure to provide more "artifacts" for student analysis.

The Bridge Connection

www.vims.edu/bridge/ – In the Navigation toolbar, click on "Ocean Science Topics," then "Human Activities," then "Heritage," then "Archeology."

The "Me" Connection

Tell students to imagine that they are living 100 years in the future. Have them write a short essay comparing and contrasting the history of steamboats with the history of the airplane.

Connections to Other Subjects

English/Language Arts

Assessment

Written reports and class discussions provide opportunities for assessment.

Extensions

1. Have students visit http://oceanexplorer.noaa.gov/explorations/08lophelia/welcome.html to find out more about the Deepwater Coral Expedition: Reefs, Rigs, and Wrecks and to learn about opportunities for real-time interaction with scientists on the current expedition.

2. For another marine archeological activity, see "Wreck Detectives" at http://oceanexplorer.noaa.gov/explorations/03portland/background/edu/media/portland-wreckdetec.pdf

Multimedia Learning Objects

http://www.learningdemo.com/noaa/ Click on the links to Lessons 3, 5, 6, 11, and 12 for interactive multimedia presentations and Learning Activities on Deep-Sea Corals, Chemosynthesis and Hydrothermal Vent Life, Deep-Sea Benthos, Energy from the Oceans, and Food, Water, and Medicine from the Sea.

Other Relevant Lesson Plans from NOAA's Ocean Exploration Program

Ship of the Line
(9 pages, 293k) (from AUVfest 2008)
http://oceanexplorer.noaa.gov/explorations/08auvfest/background/edu/media/shipline.pdf

Focus: Maritime History/Physical Science/Social Science

In this activity, students will be able to describe general characteristics and technologies used in 18th century naval ships; draw inferences about daily life aboard these ships; and explain at least three ways in which simple machines were used on these vessels.

Entering the Twilight Zone
(8 pages, 352k) (from the Expedition to the Deep Slope 2007)
http://oceanexplorer.noaa.gov/explorations/07mexico/background/edu/media/zone.pdf

Focus: Deep-sea habitats (Life Science)

In this activity, students will be able to describe major features of cold seep communities, list at least five organisms typical of these communities and will infer probable trophic relationships within and between major deep-sea habitats. Students will also be able to describe the process of chemosynthesis in general terms, contrast chemosynthesis and photosynthesis, and describe major deep-sea habitats and list at least three organisms typical of each habitat.

Animals of the Fire Ice
(5 pages, 364k) (from the Expedition to the Deep Slope 2007)
http://oceanexplorer.noaa.gov/explorations/07mexico/background/edu/media/animals.pdf

Focus: Methane hydrate ice worms and hydrate shrimp (Life Science)

In this activity, students will be able to define and describe methane hydrate ice worms and hydrate shrimp, infer how methane hydrate ice worms and hydrate shrimp obtain their food, and infer how methane hydrate ice worms and hydrate shrimp may interact with other species in the biological communities of which they are part.

A Piece of Cake
(7 pages; 282kb PDF) (from the Cayman Islands Twilight Zone 2007 Expedition)
http://oceanexplorer.noaa.gov/explorations/07twilightzone/background/edu/media/cake.pdf

Focus: Spatial heterogeneity in deepwater coral communities (Life Science)

In this activity, students will be able to explain what a habitat is, describe at least three functions or benefits that habitats provide, and describe some habitats that are typical of deepwater hard bottom communities. Students will also be able to explain how organisms, such as deepwater corals and sponges, add to the variety of habitats in areas such as the Charleston Bump.

Forests of the Deep
(4 pages, 232k) (from the 2004 Gulf of Alaska Seamount Expedition)
http://oceanexplorer.noaa.gov/explorations/04alaska/background/edu/media/GOA04.Forests.pdf

Focus: Deep-sea coral communities associated with seamounts (Life Science)

In this activity, students will be able to explain at least three ways in which seamounts are important to biological communities, infer at least three ways in which deep-sea corals are important to seamount ecosystems, and explain why many scientists are concerned about the future of seamount ecosystems.

Deep Gardens
(11 pages; 331kb PDF) (from the Cayman Islands Twilight Zone 2007 Expedition)
http://oceanexplorer.noaa.gov/explorations/07twilightzone/background/edu/media/deepgardens.pdf

Focus: Comparison of deep-sea and shallow-water tropical coral communities (Life Science)

In this activity, students will compare and contrast deep-sea coral communities with their shallow-water counterparts, describe three types of coral associated with deep-sea coral communities, and explain three benefits associated with deep-sea coral communities. Students will explain why many scientists are concerned about the future of deep-sea coral communities.

Let's Make a Tubeworm! (6 pages, 464k) (from the 2002 Gulf of Mexico Expedition)
http://oceanexplorer.noaa.gov/explorations/02mexico/background/edu/media/gom_tube_gr56.pdf

Focus: Symbiotic relationships in cold-seep communities (Life Science)

In this activity, students will be able to describe the process of chemosynthesis in general terms, contrast chemosynthesis and photosynthesis, describe major features of cold seep communities, and list at least five organisms typical of these communities. Students will also be able to define symbiosis, describe two examples of symbiosis in cold seep communities, describe the anatomy of vestimentiferans, and explain how these organisms obtain their food.

Looking for Clues
(8 pages, 556k) (from the RMS *Titanic* Expedition 2004)
http://oceanexplorer.noaa.gov/explorations/04titanic/edu/media/Titanic04.Clues.pdf

Focus: Marine archaeology of the *Titanic* (Physical Science)

In this activity, students will be able to draw inferences about a shipwreck given information on the location and characteristics of artifacts from the wreck, and will list three processes that contribute to the *Titanic's* deterioration.

Journey to the Unknown & Why Do We Explore
(10 pages, 596k) (from the 2002 Galapagos Rift Expedition)
http://oceanexplorer.noaa.gov/explorations/02galapagos/background/education/media/gal_gr5_6_l1.pdf

Focus: Ocean Exploration

In this activity, students will experience the excitement of discovery and problem-solving to learn about organisms that live in extreme environments in the deep ocean and come to understand the importance of ocean exploration.

Chemists with No Backbones
(4 pages, 356k) (from the 2003 Deep Sea Medicines Expedition)
http://oceanexplorer.noaa.gov/explorations/03bio/background/edu/media/Meds_ChemNoBackbones.pdf

Focus: Benthic invertebrates that produce pharmacologically-active substances (Life Science)

In this activity, students will be able to identify at least three groups of benthic invertebrates that are known to produce pharmacologically-active compounds and will describe why pharmacologically-active compounds derived from benthic invertebrates may be important in treating human diseases. Students will also be able to infer why sessile marine invertebrates appear to be promising sources of new drugs.

Keep Away
(9 pages, 276k) (from the 2006 Expedition to the Deep Slope)
http://oceanexplorer.noaa.gov/explorations/06mexico/background/edu/GOM%2006%20KeepAway.pdf

Focus: Effects of pollution on diversity in benthic communities (Life Science)

In this activity, students will discuss the meaning of biological diversity and compare and contrast the concepts of variety and relative abundance as they relate to biological diversity. Given information on the number of individuals, number of species, and biological diversity at a series of sites, students will make inferences about the possible effects of oil drilling operations on benthic communities.

What's In That Cake?
(9 pages, 276k) (from the 2006 Expedition to the Deep Slope)
http://oceanexplorer.noaa.gov/explorations/06mexico/background/edu/GOM%2006%20Cake.pdf

Focus: Exploration of deep-sea habitats

In this activity, students will be able to explain what a habitat is, describe at least three functions or benefits that habitats provide, and describe some habitats that are typical of the Gulf of Mexico. Students will also be able to describe and discuss at least three difficulties involved in studying deep-sea habitats and describe and explain at least three techniques scientists use to sample habitats, such as those found on the Gulf of Mexico.

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://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 focussing on the exploration, understanding, and protection of Earth as a whole system

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/ – Web site with information on naval ships, photos, etc., and a page about the Portland Gale of 1898

http://score.rims.k12.ca.us/activity/bubbles/ – Marine archaeology activity guide based on investigations of the wreck of a Spanish galleon; from the Schools of California Online Resources for Education Web site

http://www.history.com/classroom/admin/study_guide/archives/thc_guide.1378.html – Study guide for history channel program on steamboats on the Mississippi

http://www.gomr.mms.gov/homepg/lagniapp/shipwreck/ – US Department of the Interior Minerals Management Service publication, "Historic Shipwrecks of the Gulf of Mexico: A Teacher's Resource"

http://www.usatoday.com/weather/movies/ps/perfectstorm.htm – USA Today Web site with information about extreme storms

http://www.gomr.mms.gov/index_common.html – Minerals Management Service Web site

http://www.gomr.mms.gov/homepg/lagniapp/chemcomp.pdf – "Chemosynthetic Communities in the Gulf of Mexico" teaching guide to accompany a poster with the same title, introducing the topic of chemosynthetic communities and other ecological concepts to middle and high school students.

http://www.gomr.mms.gov/homepg/lagniapp/lagniapp.html – Kids Page on the Minerals Management Service Web site, with posters, teaching guides and other resources on various marine science topics

http://www.coast-nopp.org/ – Resource Guide from the Consortium for Oceanographic Activities for Students and Teachers, containing modules, guides, and lesson plans covering topics related to oceanography and coastal processes http://cosee-central-gom.org/ – Web site for The Center for Ocean Sciences Education Excellence: Central Gulf of Mexico (COSEE-CGOM)

National Science Education Standards

Content Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard B: Physical Science
- Properties and changes of properties in matter
- Motions and forces
- Transfer of energy

Content Standard D: Earth and Space Science
- Structure of the Earth system

Content Standard E: Science and Technology
- Abilities of technological design
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives
- Natural hazards
- Risks and benefits
- Science and technology in society

Content Standard G: History and Nature of Science
- Nature of science

Ocean Literacy Essential Principles and Fundamental Concepts

Essential Principle 1.
The Earth has one big ocean with many features.

Fundamental Concept g. The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean.

Fundamental Concept h. Although the ocean is large, it is finite and resources are limited.

Essential Principle 5.
The ocean supports a great diversity of life and ecosystems.

Fundamental Concept b. Most life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles.

Fundamental Concept c. Some major groups are found exclusively in the ocean. The diversity of major groups of organisms is much greater in the ocean than on land.

Fundamental Concept d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.

Fundamental Concept e. The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.

Fundamental Concept f. Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, i.e., it is "patchy". Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.

Fundamental Concept g. There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.

Essential Principle 6.
The ocean and humans are inextricably interconnected.

Fundamental Concept b. From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.

Fundamental Concept e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

Fundamental Concept g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

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 c. Over the last 40 years, use of ocean resources has increased significantly, therefore the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.

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.

Fundamental Concept f. Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.

Send Us Your Feedback

We value your feedback on this lesson.
Please send your comments to:
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Student Handout

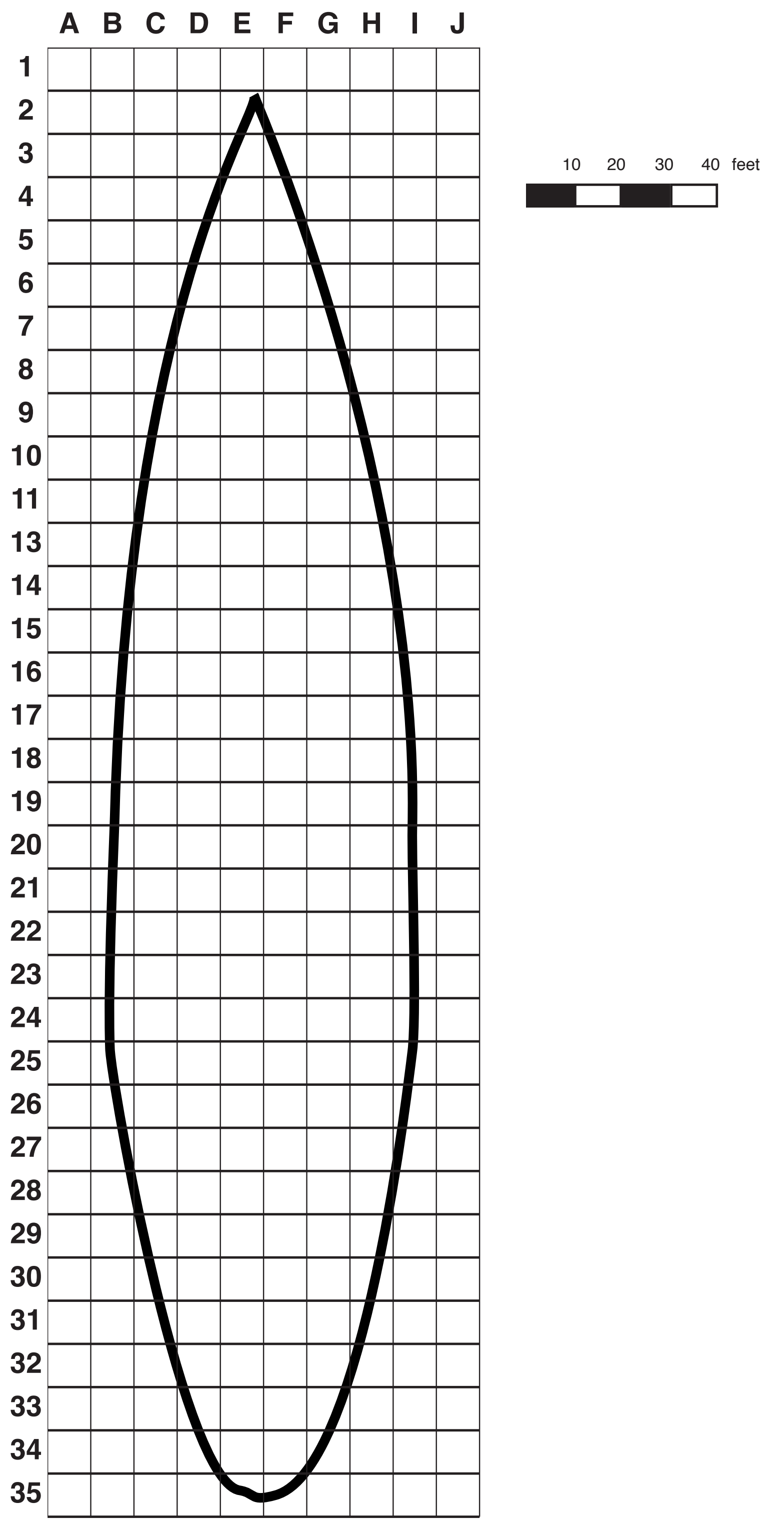
List of Artifacts Retrieved from Unidentified Shipwreck Q11WRK5

Grid Reference	Description
E19–E23 & F19-F23	Heavy metal structure, diamond shaped, partially buried
D10	Gentleman's gold ring, 55 cm from surface
E14	Heavy mahogany chair, velvet upholstery, 1 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
F14	Domed skylight, 40 cm from surface
D13	Carved mahogany headboard, 70 cm from surface
F13	Ebony piano keyboard, 55 cm from surface
C19-C24	Massive paddlewheel, partially buried
G10	Child's rocking chair, mahogany, 60 cm from surface
D13	Lady's dress shoe, 65 cm from surface
G10	Shaving straight razor, 55 cm from surface
H17	Silver buckle, 70 cm from surface
D13	China chamber pot, 60 cm from surface
E11	Carving knife, 2.3 m from surface
D10	Man's leather dress shoe, 60 cm from surface
B13	Carved wooden plank, letters "RTLAND;" left side broken
E11	Silver serving platter, 2.3 m from surface
E5	Rusted iron mass, possibly chain
F21	Heavily rusted iron mass, possibly tools, 2.5 m from surface
E11	Ship's wheel, 30 cm from surface
D10	Small mahogany chest of drawers, 70 cm from surface
E33	Rudder, partially buried
G19-G24	Massive paddlewheel, partially buried
E17 & F17	Smokestacks

NOTE: Extensive debris around main wreck, mostly large timbers and pieces of heavy equipment; several lifeboat remnants outside main wreck. Less obvious structural debris in quadrats numbered 25 and higher; these quadrats contain mostly silt down to the apparent hull of the vessel at approximately 3.5 m.

Student Handout

Grid Reference System for Unidentified Shipwreck Q11WRK5



Student Handout

The Story of the Steamship *Portland* and the Gale of 1898

On Thanksgiving Saturday, November 26, 1898, the passenger steamship *Portland* left Boston Harbor with more than 190 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 thirty miles northeast of Boston. But the *Portland* was apparently unable to make much more progress against the storm.

At 5:45 am 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.