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AUVfest 2008

Shipwreck Mystery

Focus
Marine Archaeology

Grade Level
7-8 (Earth Science/Physical Science/Social Science)

Focus Question
How can marine archaeologists use historical and archaeological data to draw inferences about the age and identity of 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 use a grid system to document the location of artifacts recovered from a model shipwreck site.

Students will be able to identify and explain types of evidence and expertise that can help verify the nature and historical content of artifacts recovered from shipwrecks.

Materials
- ❒ Copies of "Investigation of a Shipwreck in Newport Harbor, Rhode Island" one copy for each student group
- ❒ Internet access

Audio/Visual Materials
None

Teaching Time
One or two 45-minute class periods, plus time for student research

Seating Arrangement
Groups of 3-4 students

Maximum Number of Students
30

Key Words
Revolutionary War
Shipwreck
Underwater archaeology
Debris field
Artifact

Background Information
On August 5, 1778, Captain John Symons gave the order to burn and sink his own ship, the British frigate HMS *Cerberus*, in Newport Harbor on the coast of Rhode Island. This was probably a difficult order for Captain Symons, but he was not alone: several other ships also were deliberately sunk when the British learned that a French fleet was headed for Newport under the command of Charles Henri Theodat, better known as Count D'Estaing. In February that same year, France had declared war on Britain as part of a treaty with America (this was the first document that officially recognizes America as an independent nation). D'Estaing left France on April 13, 1778 with a fleet of 12 ships of the line and five frigates to supplement the Continental Navy's efforts to attack the British fleet on the North

American coast. After arriving too late to confront British ships in Delaware and unable to cross a sandbar to meet them in New York, D'Estaing finally came to grips with British ships in Newport Harbor. The British sank their ships to prevent the revolutionaries from capturing the vessels for their own use, as well as to obstruct navigation within the harbor; a strategy which ultimately proved to be successful, since it helped prevent D'Estaing from entering the harbor and capturing Newport.

Almost 230 years later, the *Cerberus* is once again receiving attention from the American Navy, this time in partnership with NOAA's Ocean Exploration Program as part of the Autonomous Underwater Vehicle Festival 2008 (AUVfest 2008). Since 1997, the U. S. Navy's Office of Naval Research has sponsored Autonomous Underwater Vehicle Festivals (AUVfests) to demonstrate the capabilities of autonomous underwater vehicles (AUVs) for doing scientific and military work. In previous years, the emphasis has been on mine countermeasures and how AUVs can remove humans from the dangerous job of finding and destroying mines. AUVfest 2008 will expand this focus to include marine archeology using AUVs to map shipwrecks and discover long-buried artifacts.

These activities will take place at the Naval Undersea Warfare Center's Narragansett Bay Test Range off Newport, Rhode Island. In addition to being a site where Navy torpedos were tested for many years, Narragansett Bay is the site of many shipwrecks (if you want to get an idea about how many wrecks are in Narragansett Bay, visit http://www.wrecksite.eu/wreck.aspx?16438, click the "show wks" box near the bottom of the page, then click inside the red rectangle just below). In addition to finding and mapping buried mines, mine neutralization, and other mine countermeasure operations, AUVs will explore five marine archaeological sites including two Revolutionary War-era British frigates (the *Cerberus* is one) and two wrecks of 20th-century ships.

Archeology is the study of past civilizations and ways of life. Like other sciences, the goal of archeology is to understand these ways of life, not merely to describe their remains. "Marine Archeology" is archeology that takes place underwater. Archeological activities are fundamentally different from salvage or treasure hunting activities whose primary goal is collecting objects and artifacts. In some cases, archeology may include artifact retrieval; but when objects are recovered primarily for their commercial or souvenir value, important archeological evidence is almost always destroyed.

Most marine archeological investigations involve six major steps:

1. Research to provide the basic information needed for an overall project plan;
2. Search to locate the investigation's target site;
3. Investigation which includes preparing detailed maps of the target site, and possibly excavation, recovery of artifacts, and other activities that provide useful information (this is the step that most people imagine when they think of "archeology");
4. Post-Survey Research to analyze data collected during the Investigation step and "decode the clues" provided by physical evidence from the target site;
5. Cultural Resource Management, including preservation and storage of artifacts that may have been collected, as well as Cultural Resource Management plans to protect investigation sites from looters and souvenir hunters; and
6. Communication to make findings of the investigation available to other archeologists and the general public; publication of results and interpretations is an essential part of every archeological project, and an archeological investigation has very little value without this step.

AUVfest 2008 is focussed on increasing marine

archeologists' understanding of how AUV technology can be used to discover and study underwater cultural resources. Key questions related to this goal include:

- How can AUV and mine countermeasures technology be applied to archeological investigations of selected shipwrecks?
- How can mine countermeasures technology be used to identify materials and objects that are not normally MCM targets, such as glass, ceramics, and wood artifacts?
- How can AUV/MCM technology be extended for other purposes and benefits in addition to national defense?

In this lesson, students will analyze underwater archeological data to draw inferences about an ancient shipwreck.

Learning Procedure

1. To prepare for this lesson, review the background essays for AUVfest 2008 at http://www.oceanexplorer.noaa.gov/explorations/08auvfest/. If students will not have access to the internet for research, you will also need to download suitable materials, or confirm that such materials are available in libraries to which students have access.

2. Introduce AUVfest 2008, and discuss some of the reasons that scientists are interested in shipwrecks. Discuss the steps in a typical marine archeological investigation. Be sure students understand that the primary purpose of these investigations is to better understand past civilizations and ways of life, as well as the distincton between archeologial and "treasure hunting."

   You may want to discuss some aspects of ships that were used during the Revolutionary War. A keyword search using "ship" and "Revolutionary War" will produce many useful internet sites. It is interesting to note that while Britain's Royal Navy had many more ships than the Continental Navy (about 131 British ships of the line compared to a total of 31 vessels in the Continental Navy), many British ships were in poor repair due to the Seven Years' War. In fact, it has been estimated that only 39 British ships of the line could have been battle-ready in the first year of the Revolutionary War; not nearly enough to patrol the long coastline of the 13 colonies. To bolster the Continental Navy, privately owned armed ships called "privateers" were given commissions to attack enemy merchant vessels. In total, colonial privateers took about 600 British vessels during the war. In some cases (such as the *Cerberus*), captains chose to sink or burn their own ships to prevent capture by the colonists.

3. Tell students that they are going to assume the role of consulting marine archaeologists investigating a shipwreck found in Newport Harbor, Rhode Island. Say that background research on shipwrecks in this area suggests that the wreck might be one of seven ships. Their assignment is to analyze artifacts collected from sites near the ship, and draw inferences about the vessel, possible reasons for the vessel's sinking, and the lifestyles of people who were on board.

4. Provide each student group with copies of "Investigation of a Shipwreck in Newport Harbor, Rhode Island." Note that the artifact inventory is based on artifacts that have actually been recovered from wreck sites of Revolutionary War-era ships. Students should first group the artifacts according to the site from which they were recovered. Students should study the artifacts found at each of the sites, research the names of unfamiliar items, and develop inferences about the purpose of the vessel, the people who were aboard, probable cause of the vessel's sinking, and the most likely identity of the ship. Have each student group prepare a short report on their analyses, citing evidence from the debris field to support their conclusions.

5. Lead a discussion of students' results. Key points should include:
   - Planks near the bow of the wreck had many nail holes whose spacing matched the distance between the frames ("ribs") of the vessel. But farther aft (toward the stern of the vessel) there were fewer holes, suggesting that construction of the ship was rushed to completion, and/or that there was a shortage of nails. Similarly, several of the ribs and other large wooden pieces still had bark attached, suggesting that the builders did not take time to trim and neatly shape these pieces; perhaps because construction was rushed. These inferences would be consistent with a vessel constructed during wartime. *Juno*, *Lark*, and *Flora* were constructed during the Seven Years' War (1756-1763), while *Kingfisher* and *Defence* were constructed during the Revolutionary War.

   - Frames near the stern of the vessel were broken or cracked, and a large crack was found in the keel in the same area. These observations suggest an explosion, perhaps in the vessel's magazine that may have contributed to her sinking. The presence of grenades in the same area also suggests that the magazine was probably located in this area. This kind of explosion might have been caused by enemy cannon fire, accidental detonation, or deliberate action by the ship's crew if they were trying to scuttle the vessel. Note that *Orpehus*, *Juno*, *Lark*, *Flora*, *Defence*, and *Kingfisher* were scuttled to avoid capture by the enemy.

   - Cannonballs scattered around the site suggest that the vessel may have been used for combat purposes, or at least was prepared for hostile encounters during her voyage. The markings on the two cannons showing that they were cast in 1778 at the Massachusetts State Foundry suggest that these guns probably belonged to *Defence*, since it is the only vessel built after 1778. It is possible, however, that these guns could have been brought on board any of the other vessels, since they all sank in August 1778 or later.

   - Many different styles of buttons and shoe buckles were recovered. Some of these were well-made and decorative, while others were roughly made from wood, bone, or leather. This variety suggests that some of the people aboard were relatively wealthy compared to others, such as the different economic status that would exist between officers and seamen.

   - Fire-blackened bricks near a large copper cauldron indicate that the ship's galley was located just behind the foremast. Other artifacts related to food and cooking give an interesting picture of what life may have been like for sailors aboard the ship. Numerous barrels found near the brick stove probably contained salt beef or pork, an inference that is strengthened by barrel head inscribed, "Pork, 32 pieces." Mugs, bowls, pewter spoons, mess kids, and small carved wooden tags were all part of the sailors' daily routine. On 18th century sailing vessels, the ship's crew were divided into "mess sections" of about six men each. When it was time to eat, one sailor from each mess section (known as the "captain of the mess section") went forward to the galley and carried food back to his section. Because the food was cooked in one big pot, it was easiest for the cook to have meat in large chunks. The mess captains identified their assigned chunks by the wooden tags, carried them back in a wooden bucket called a "mess kid," and divided the chunks among his mess mates. One of these mess kids was inscribed "1779." Assuming this signified a particular year, the mess kid most likely came from *Falcon* or *Defence*, since of the seven ships these are the only ones that were still afloat in 1779.

- The evidence of the mess kid, combined with the evidence of a severe explosion indicates that the shipwreck is most likely *Defence*, since *Falcon* was not scuttled but foundered during a storm. This conclusion is supported by evidence from the cannon markings. Students may also realize that *Defence* was the smallest of the seven vessels, and the overall size of the shipwreck would probably be sufficient evidence to distinguish remains of *Defence* from those of the other ships.

NOTE: The clues provided on the student worksheet are adapted from actual archeological investigations of the *Defence* shipwreck site. *Defence* sank in Penobscot Bay, Maine, however; not Newport Harbor.

The Bridge Connection

http://www.vims.edu/bridge/archive1200.html – Activities and links about shipwrecks

The "Me" Connection

Have students write a brief essay describing why knowing about past civilizations and ways of life is important or useful, and how archeological investigations might affect their lives personally.

Connections to Other Subjects

English/Language Arts, Social Studies, History, Physical Science

Assessment

Student analyses and reports offer opportunities for assessment.

Extensions

For another marine archeology activity, see the "Lost at Sea: Sunken Slave Ship" activity from Newton's Apple episode 1502. You can access this activity from http://www.ktca.org/newtons/15/sunken.html.

Other Relevant Lessons from the Ocean Exploration Program

Sonar Simulation

http://oceanexplorer.noaa.gov/explorations/08bonaire/background/edu/media/sonarsim.pdf (PDF, 308kb)
(from the Bonaire 2008: Exploring Coral Reef Sustainability with New Technologies Expedition)

Focus: Side scan sonar (Earth Science/Physical Science)

In this activity, students will describe side-scan sonar, compare and contrast side-scan sonar with other methods used to search for underwater objects, and make inferences about the topography of an unknown and invisible landscape based on systematic discontinuous measurements of surface relief.

I, Robot, Can Do That!

http://oceanexplorer.noaa.gov/explorations/05lostcity/background/edu/media/lostcity05_i_robot.pdf
(9 pages, 357k) (from the 2005 Lost City Expedition)

Focus - (Physical Science/Life Science)
Underwater Robotic Vehicles for Scientific Exploration

In this activity, students will be able to describe and contrast at least three types of underwater robots used for scientific explorations, discuss the advantages and disadvantages of using underwater robots in scientific explorations, and identify robotic vehicles best suited to carry out certain tasks.

This Old Ship

http://oceanexplorer.noaa.gov/explorations/06greece/background/edu/media/old_ship.pdf
(9 pages, 272 kb) (from the 2006 Phaedra Expedition)

Focus: Ancient and Prehistoric Shipwrecks
In this activity, students will be able to describe

at least three types of artifacts that are typically recovered from ancient shipwrecks, explain the types of information that may be obtained from at least three types of artifacts that are typically recovered from ancient shipwrecks, and compare and contrast, in general terms, technological features of Neolithic, Bronze Age, Hellenistic, and Byzantine period ships.

Mapping the Aegean Seafloor

http://oceanexplorer.noaa.gov/explorations/06greece/background/edu/media/seafloor_mapping.pdf
(8 pages, 288 kb) (from the 2006 Phaedra Expedition)

Focus: Bathymetric mapping of deep-sea habitats

In this activity, students will be able to create a two-dimensional topographic map given bathymetric survey data, create a three-dimensional model of landforms from a two-dimensional topographic map, and interpret two- and three-dimensional topographic data.

Other Links and 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 – Web site for NOAA's Ocean Exploration program

Green, J. 2004. Maritime Archaeology, Second Edition: A Technical Handbook. Academic Press.

Bass, G.F. (ed.). 1996. Ships and Shipwrecks of the Americas: A History Based on Underwater Archaeology. Thames & Hudson.

Bound, M. 1998. Excavating Ships of War. Anthony Nelson.

http://ina.tamu.edu/vm.htm – The Institute of Nautical Archaeology's Virtual Museum

http://projectsx.dartmouth.edu/history/bronze_age/ – Dartmouth University Web site, "Prehistoric Archaeology of the Aegean," with texts, links to other online resources, and numerous bibliographic references

http://ina.tamu.edu/Sercelimani.htm – The Byzantine Shipwreck at Serçe Limani

http://ina.tamu.edu/ub_main.htm – Web site with information about the excavation of a Bronze Age shipwreck at Uluburun, Turkey

http://sara.theellisschool.org/shipwreck – The Uluburun Shipwreck web site

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

Macaulay, D. 1993. Ship. Houghton Mifflin Company. Boston.

http://www.marinetech.org/rov_competition/rov_video_2007.php – Video from the the Marine Technology Society's student ROV competition

Bohm, H. and V. Jensen. 1998. Build Your Own Programmable Lego Submersible: Project: Sea Angel AUV (Autonomous Underwater Vehicle). Westcoast Words. 39 pages.

Bohm, H. 1997. Build your own underwater robot and other wet projects. Westcoast Words. 148 pages.

National Science Education Standards

Content Standard A: Science As Inquiry

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

Content Standard B: Physical Science

- Properties and changes of properties in matter

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
- Science and technology in society

Content Standard G: History and Nature of Science

- Science as a human endeavor

Ocean Literacy Essential Principles and Fundamental Concepts

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 c. The ocean is a source of inspiration, recreation, rejuvenation and discovery. It is also an important element in the heritage of many cultures.

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.

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

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Student Handout

Investigation of a Shipwreck in Newport Harbor, Rhode Island

Recreational divers have discovered the remains of an sunked wooden ship that appears to be quite old. Your background research has identified seven ships that are believed to have sunk in or near this area. A marine archeological investigation has been launched to investigate the wreck, and a large number of artifacts have been recovered. As the artifacts were collected, their location on the wreck site was recorded using a grid system as shown in Figure 1. Your job is to analyze these artifacts and their locations to make inferences about the purpose of the vessel, what caused the vessel to sink, and the most likely identity of the ship.

Here are the ships that may have sunk in the investigation area:

HMS *Orpheus*; 5th Rate; 32 cannons; 708 tons; 130x35 ft; Built in 1773;
Abandoned and burnt on 15th August 1778, off Rhode Island.

HMS *Juno*; 5th Rate; 32 cannons; 667 tons; 128x34.5 ft; Built in 1757;
Burnt on 7th August 1778 on Rhode Island to avoid capture.

HMS *Lark*; 32 cannons; 5th Rate; 710 tons; 126x36 ft; Built in 1762;
Burnt on 7th August 1778 to avoid capture.

Defence; Brig; 16 cannons; 170 tons; Built 1779; Scuttled 14th August 1779 to avoid capture.

HMS *Flora*; 5th Rate; 32 cannons; Taken from the French in 1761; Scuttled 1778.

Falcon; Sloop; 14 cannons; 302 tons; 95x27 ft; Built in 1771; Foundered in 1779.

HMS *Kingfisher*; Sloop; 14 cannons; 302 tons; 97x26.5 ft; Built in 1770;
Burnt on 7th August 1778 near Rhode Island to avoid capture.

Inventory of Artifacts Recovered from the Newport Harbor Debris Field

Quantity	Item	Grid Cell
9	planks, many nail holes; spacing of holes matches the distance between frames ("ribs")	0,5
1	frame, bark still attached on three sides; cracked in several places; detached from hull	0,0
10	buttons, pewter, decorative	1,1
15	grenades, primed and fuzed	1,1
23	spoon, pewter	1,3
5	frames, bark still attached on three sides; cracked in several places; detached from hull	1,0
5	mess kid, wooden; one inscribed: "1779"	1,5
7	planks, scattered nail holes; spacing of holes much farther apart than the distance between frames ("ribs")	0,2
1	portion of vessel keel, cracked by downward force	1,1
1	cannon, 6 pounder; marked "Massachusetts St Foundry 1778"	1,5
7	buttons, pewter, decorative	2,2
4	frame, bark still attached on three sides; cracked in several places; detached from hull	2,0
15	buttons, bone, rough	0,4
13	cannonball	1,6
13	planks, many nail holes; spacing of holes matches the distance between frames ("ribs")	2,1
1	cannon, 6 pounder; marked "Massachusetts St Foundry 1778"	2,3
19	buttons, wood, rough	1,6
11	planks, many nail holes; spacing of holes matches the distance between frames ("ribs")	2,6
14	buttons, leather, rough	2,4
9	cannonball	2,4
1	copper cauldron	1,4
7	buttons, bone, rough	1,3
15	cannonball	0,6
3	shoe buckle, pewter	1,2
1	shoe, leather, fine stitched	1,2
17	bowls, wooden	1,2
17	cannonball	2,2
8	shoe buckle, leather	1,4
79	bricks, fire-blackened	1,4
19	barrels, wood	1,4
9	cannonball	0,4
5	buttons, pewter, decorative	0,4
1	barrel cover, wood; inscribed: "Pork, 32 pieces"	1,4
3	mess kid, wooden	2,3
13	tags, wood, carved	1,4
12	cannonball	0,2

Figure 1. Sketch Map of the Newport Harbor Debris Field Survey Sites