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AUVfest 2008

Ship of the Line

Focus
Marine Archaeology

Grade Level
5-6 (Earth Science/Physical Science/Social Science)

Focus Question
What technologies were used aboard 18th-century naval ships, and what was life like for those who sailed these ships?

Learning Objectives
Students will be able to describe general characteristics and technologies used in 18th-century naval ships.

Students will be able to draw inferences about daily life aboard 18th-century naval ships.

Students will be able to explain at least three ways in which simple machines were used on 18th-century naval ships.

Materials
- ❒ Copies of "18th-century Naval Ships Student Worksheet," one copy for each student or 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
18th-century
Ship
Frigate
Ship of the line
Maritime history

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 investigate some features of 18th-century ships and the lives of people who sailed them.

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. Briefly relate the story of the *Cerberus*, and ask students what they imagine life was like aboard 18th-century sailing ships. Many students may have seen the film, Master and Commander. Remind them that the historical period of the film was the Napoleonic Wars (1803-1815); roughly 30 years after the American Revolution. Distribute copies of the Student Worksheet to each student or student group. Tell students that their assignment is to use internet or library resources to find answers to the worksheet questions.

3. Discuss students' answers to the worksheet questions. This discussion should include:

1. Discovery terms

brig (brigantine) – a two-masted vessel with the fore mast square rigged; brig may also refer to a space aboard a ship that is used as a jail

fifth-rate – In the 18th century, sailing warships were rated by the number of guns they carried. A first-rate ship carried 100-110 guns; a second-rate ship carried 84-100 guns; a third-rate ship carried 70-84 guns; a fourth-rate ship carried 50-70 guns; a fifth-rate ship carried 32-50 guns; a sixth-rate ship carried up to 32 guns. Only ships with 70 guns or more were considered powerful enough to be ships of the line (see below). Fifth- and sixth-rate ships were generally known as frigates, and were faster than the larger and heavier ships of the line.

frigate – a warship; in the 18th century, a square-rigged ship that may be as long as a ship-of-the-line, but is lighter (and therefore faster); often used for patrolling and escort duties

magazine – the ammunition storage area aboard a warship

master and commander – the full title of a rank in the Royal Navy equivalent to a major in the British Army; the title was shortened to commander in 1814; the corresponding title in the U.S. Navy was "Master Commandant"

mess or mess section – a group of six sailors who eat their meals together

mess kid – a wooden bucket used to carry food from the galley to a mess section

mess tag – a wooden tag used to identify the food assigned to a particular mess section

privateer – a captain or ship that has his government's permission to pursue and capture ships belonging to enemy nations

sailing master – In the Royal Navy in the-days of sail, the Sailing Master was the officer responsible for the navigating and

steering the ship

ship of the line – a type of naval warship; the name comes from a naval tactic known as the line of battle, in which two columns of opposing warships would maneuver so that the cannons projecting from one side of each ship would fire into the enemy vessels [Note: This tactic sounds pretty risky and destructive, and it definitely was! Battles fought in this way were usually won by the heaviest ships carrying the most powerful guns, so navies tried to build sailing vessels that were as large and powerful as possible.]

sloop – a single-masted fore-and-aft-rigged sailing vessel with a single headsail set from the forestay

2. Describe the general characteristics of 18th-century naval ships: What materials were used for their construction? How were they powered? How many people were needed to operate them?

   Eighteenth-century naval ships were sailing vessels made from various kinds of wood, but metals were also essential to their construction. Iron and steel were used for fasteners (nails and bolts) and for many other pieces of hardware including tools, cannon, chain, and anchors. Brass and bronze were useful because they do not rust, but are not as strong as steel and iron. Canvas and rope were used for sails and rigging, as well as for equipment such as pumps where highly flexible materials were needed. Glass was used for windows. Tar and pitch were used to make ships' hulls watertight (more or less). Ceramics were used for various utensils as well as cooking stoves. Size of ships and number of crew were greatly influenced by the number of guns on board, since each gun required at least five or six crew members when in battle, and additional crew were needed to sail the vessel. A first-rate ship of the line carrying 100 or more guns would need a crew of more than 800. The size crew needed to man a frigate carrying 20 - 60 guns ranged from about 120 - 420. Smaller sloops with 15 - 20 guns usually had crews around 100. The smallest naval vessels had crews as small as 5, but these would have been confined to harbor and coastal duties.

3. Eighteenth-century naval ships were among the most advanced technological achievements of their time, and were able to travel around the globe. Their construction depended upon many different technical skills, some of which are quite rare today. Ship construction required detailed knowledge of how a vessel's size and shape would influence her behavior when under sail. Ship builders were faced with the challenge of making vessels strong enough to carry heavy cannons and withstand the force of ocean storms, and at the same time keeping ships light enough to achieve an acceptable speed. Knowledge of the structural properties of various woods was essential, and many different types of wood were used for mast, frames, planks, and other ship components. Production of metal parts required metallurgical and blacksmithing skills. Navigating ships around the globe required knowledge of astronomy and mathematics. Medical skills were also essential on all ships. Even without battle injuries, sailors were prone to a variety of injuries and diseases. Scurvy, caused by a dietary deficiency of vitamin C, was a serious problem for ships' crews until the Royal Navy surgeon James Lind demonstrated in 1753 that the disease could be avoided and treated with citrus fruit.

4. Food
   The "official" diet for sailors in the Royal Navy was something like this:

Sunday – 1 pound pork, 1/2 pint peas
Monday – 1 pint oatmeal, 2 ounces butter
Tuesday – 2 pounds beef
Wednesday – 1/2 pint peas, 1 pint oatmeal, 2 ounces butter, 4 ounces cheese
Thursday – Same as Sunday
Friday – Same as Monday
Saturday – Same as Tuesday
In addition, sailors received a pound of biscuit and a gallon of beer daily.

The ship's purser was responsible for distributing these rations, and was allowed to keep one-eighth of all food as protection against "Waste, Shrinkage, Loss, &c." So, a pound was actually equal to fourteen ounces instead of sixteen, and a gallon was equal to seven pints instead of eight.

Pork and beef came packed in barrels of four pound pieces, pickled in brine, and known to the men as 'salt horse.' Peas, oatmeal, and flour came dried in barrels or bags. Butter was found in small tubs called firkins, which also indicated the weight they held.

When the "official" foods were not available, the purser was allowed to make certain substitutions. For example:

- A pint of wine, or half a pint of brandy or rum, could be substituted for a gallon of beer;
- Four pounds of flour, or three pounds of flour plus a pound of raisins could be substituted for a four pound piece of beef, or a two pound piece of pork with peas;
- Half a pound of rice could be substituted for a pint of oatmeal.

"Portable soup" was another food that was often substituted for the prescribed rations. Invented by a Mrs. Dubois around 1756, portable soup was made of vegetables and various organ meats (liver, kidney, heart, etc.) boiled together then allowed to cool and harden. The mixture was then cut into slabs and boxed. Captain Cook carried portable soup on his voyages in the 1770s, and it was still in use during the Napoleonic Wars. Although the original idea was that portable soup could help prevent scurvy, it actually had no effect on this disease.

Sauerkraut was a much less popular preserved food. Although it was supposed to be a favorite food of King George III and was also recommended by Captain Cook, most sailors hated sauerkraut, and many captains refused to even carry it.

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.

5. All of the well-known "simple machines" were used on 18th-century naval ships. Pulleys were used extensively in rigging to handle sails, as well as for moving heavy objects on, off, and around ships. Inclined planes were also used to bring cargo (especially in barrels) aboard ship. Levers were used to maneuver cannons, as well as on windlasses to raise anchors. Wedges (another form of inclined plane) appear in many tools such as axes, adzes, planes, and knives used to construct and repair wooden ships. Augurs or screws are yet another variety of inclined plane used to drill holes for

fasteners that hold pieces of ships together. Wheels and axles are found on cannon carriages, and of course, at the ship's helm where a large wheel is attached to the rudder for steering.

6. Fanny Campbell was probably the first woman to captain a privateer against the British during the American Revolution. A few months before the war began, Fanny Campbell disguised herself as a man and enlisted on an English merchant brig, the *Constance*. Her motive was that she wanted to rescue her boyfriend, William Lovell, from a jail in Cuba. Once the *Constance* was at sea, Campbell led a successful mutiny and became commander of the stolen brig. Eventually, after a few other adventures, Fanny Campbell and her fellow pirates successfully rescued William Lovell along with ten other jailed Americans. Soon afterward, war officially began between Britain and the colonies, so Fanny Campbell was no longer considered a pirate, and was able to return to Massachusetts to receive a commission as a privateer. She married William Lovell who continued to privateer throughout the war while Fanny Campbell stayed ashore and raised a large family.

The Bridge Connection

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

The "Me" Connection

Have students write a short essay in which they imagine themselves as a sailor aboard an 18th-century naval ship and describe a typical day, including descriptions of how technology affects their life at sea.

Connections to Other Subjects

English/Language Arts, Social Studies, History

Assessment

Student analyses and reports offer opportunities for assessment.

Extensions

1. 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.

2. Visit http://celebrating200years.noaa.gov/edufun/book/welcome.html for more activities related to ships and nautical life.

Other Relevant Lessons from the Ocean Exploration Program

Looking for Clues

(8 pages, 556k) http://oceanexplorer.noaa.gov/explorations/04titanic/edu/media/Titanic04.Clues.pdf

Focus: Marine archaeology of the Titanic

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.

Wreck Detectives

http://www.oceanexplorer.noaa.gov/explorations/03portland/background/edu/media/portlandwreckdetec.pdf
(5 pages, 384k) (from the 2003 Steamship Portland Expedition)

Focus: Marine archaeology (Physical Science)

In this activity, students use a grid system to document the location of artifacts recovered from a model shipwreck site, use data about the location and types of artifacts recovered from a model shipwreck site to draw inferences about the sunken ship and the people who were aboard, and identify and explain types of evidence and expertise that can help verify the nature and historical

context of artifacts recovered from shipwrecks.

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.

Villiers, A. 1973. Men, Ships and the Sea. National Geographic Society. Washington.

http://www.navyandmarine.org/ondeck/ – On Deck! from the Navy & Marine Living History Association, with articles and information for naval re-enactors and others having an interest in nautical history

http://www.wrecksite.eu/content/archive/vocabulary.aspx – Vocabulary of nautical terms

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

- Motion and forces

Content Standard E: Science and Technology

- Abilities of technological design
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

- Science and technology in society

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.

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 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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oceanexeducation@noaa.gov

For More Information

Paula Keener-Chavis, Director, Education Programs
NOAA Ocean Exploration Program
Hollings Marine Laboratory
331 Fort Johnson Road, Charleston SC 29412
843.762.8818
843.762.8737 (fax)
paula.keener-chavis@noaa.gov

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Student Worksheet
18th-Century Naval Ships

1. Define or explain these terms:

   brig or brigantine

   fifth-rate

   frigate

   magazine

   master and commander

   mess or mess section

   mess kid

   mess tag

   privateer

   sailing master

   ship of the line

   sloop

2. Describe the general characteristics of 18th-century naval ships. What materials were used for their construction? How were they powered? How big were they? How many people were needed to operate them?

3. Describe at least three types of technology or knowledge that were needed to operate 18th-century naval ships.

4. Describe the food that sailors might have had on an 18th-century naval ship.

5. Explain at least three ways in which simple machines were used on 18th-century naval ships.

6. Who was Fanny Campbell?