Underwater Archaeology

Subject: Science, Social Studies
Duration: 2 Hours
Location: Classroom

Sunshine State Standard
LA.A. 1.1 LA.C.1.1 LA.C.3.1 SC.F.1.1 SC.G.1.1 SC.G.2.1 SC.H.1.1 SC.H.3.1 SS.A.1.1 SS.B.1.1 SS.B.2.1 SS.D.1.1 VA.E.1.1 LA.A.1.2 LA.A.2.2 LA.C.1.2 LA.C.3.2 SC.A.1.2 SC.D.2.2 SC.F.1.2 SC.F.2.2 SC.G.1.2 SC.G.2.2 SC.H.2.2 SC.H.3.2 SS.A 1.3 SS.A 2.3 SS.A 6.3 SS.B 2.3 VA.A.1.2 VA.E.1.2 LA.A.1.3 LA.A.2.3 LA.C.1.3 LA.C.2.3 LA.C.3.3 LA.E.2.3 SC.E.2.3 SC.F.1.3 SC.G.1.3 SC.G.2.3 SC.H.3.3 SS.A.1.3SS.B.1.3 SS.B.2.3 VA.A.1.3 VA.E.1.3 LA.A.1.4 LA.A.2.4 LA.B.2.4 LA.C.1.4 LA.C.2.4 LA.C.3.4 LA.E.2.4 SC.F.1.4 SC.G.1.4 SC.G.2.4 SC.H.3.4 SS.A.1.4 SS.B.1.4 SS.B.2.4 VA.A.1.4 VA.E.1.4

Objectives

Students will:

- Students will gather data from physical clues.
- Students will learn to form hypotheses based on observed data.
- Students will map a mock underwater archaeological site.
- Students will discuss the importance of preserving shipwrecks intact.
- Students will use the data gathered to develop evidence

Vocabulary

Artifact - is any object made or modified by a human

Archaeology –is the science that studies human cultures through the recovery, documentation, analysis, and interpretation of material culture and environmental data, including architecture, artifacts, biofacts, and landscapes.

ROV –A remotely operated vehicle (ROV) is a tethered underwater robot.

Underwater archaeology is the study of past human life, behaviors and a culture using the physical remains found in salt or fresh water or buried beneath water-logged sediment. It is most often considered as a branch of maritime archaeology.

Background

http://www.acuaonline.org/whatis.html
www.wikipedia.com

Introduction

Covering nearly three-quarters of the Earth's surface, water is the source of all life on our planet. Water-borne transportation has allowed exploration of much of the globe and facilitated the rise and fall of great empires. Beneath the surface of our oceans, lakes, rivers, and wetlands lies a physical record of humankind preserved in prehistoric and historic shorelines, shipwrecks, inundated cities, harbor works, and other traces of our past.

Archaeology is the scientific study of the human past through investigation of artifacts (the physical remains of cultures), structures, the use of animals and plants, and human remains. Its goal is greater knowledge about past human culture and behavior. Underwater archaeology carries these studies into a specialized environment, one containing numerous challenges and rewards for archaeological investigators.

The majority of underwater archaeologists specialize in the study of nautical archaeology: the study of ships, shipping, and the construction and operation of all types of prehistoric and historic watercraft. For these specialists, shipwrecks are the focus of research, many of which (but by no means all) may be found underwater.

Other types of sites in the underwater archaeologists' domain include: ancient land sites inundated after the last ice age; sinkholes or bogs where people placed offerings or buried their dead; cities and harbors now submerged from sea level change or earthquake; and dwelling, agricultural, and industrial sites along rivers, bays, and lakes. Underwater archaeologists make extensive use of historical records such as ships' plans, logs, and manifests; explorer's accounts; old maps; and legal, business, and tax records. They also study long-term geologic changes to locate submerged early man sites.

Putting it All Together
The practice of underwater archaeology is truly interdisciplinary, combining the methods of various allied fields of study including anthropology, chemistry, ethnography, geology, history, naval architecture, oceanography, and paleography -- to name only a few.

Although much underwater archaeology is conducted with standard scuba equipment, using simple measuring, mapping, and drawing techniques, archaeologists have borrowed special methods for working in the underwater environment from marine science as well as commercial and military diving. Technologically sophisticated projects use both acoustic and magnetic remote-sensing equipment for detecting underwater archaeological sites, and acoustic, optical, infrared, and robotic methods for pinpointing, mapping, and documenting sites.

Archaeological Conservation
Underwater archaeology does not always involve excavation, but when material is removed for detailed study, laboratory facilities available to preserve the artifacts are essential. The miraculously well-preserved condition of objects is more apparent than real.

Photos courtesy Projecto HMS Swift and Ships of Discovery

During lengthy immersion, artifacts react chemically with the water and sediments surrounding them. Sudden removal from their watery environment and exposure to air can set off a chain of chemical and physical reactions in the objects that can lead to their destruction.

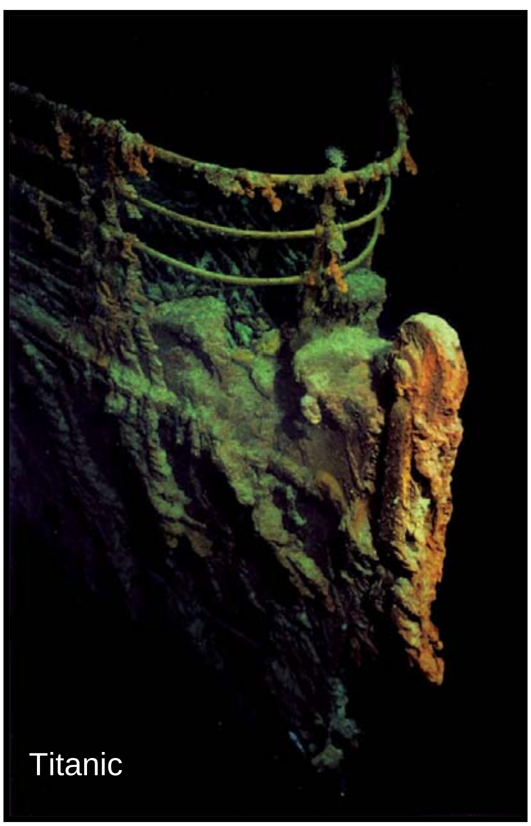
Conservators are specialists who work with archaeologists to preserve artifacts for study and display. The conservation of objects takes much longer than their actual excavation, and the long-term care of a collection of excavated objects is expensive and time-consuming. Unless proper facilities and resources are available, it is often best to leave objects in their underwater environment. Conservators also work with archaeologists and site managers to monitor the condition of sites and artifacts left in place to preserve them for future generations

Definition

Underwater archaeology is the study of past human life, behaviors and a culture using the physical remains found in salt or fresh water or buried beneath water-logged sediment. It is most often considered as a branch of maritime archaeology. Due to the difficulties of accessing underwater sites, the application of archaeology to underwater sites emerged from the skills and tools developed by salvager, and underwater archaeology initially struggled to establish itself as proper archaeological research.

Underwater archaeological sites consist of wrecks (shipwrecks or aircraft); the remains of structures created in water (such as crannogs, bridges or harbors); refuse or debris sites where people disposed of their waste, garbage and other items by dumping into the water; or places where people once lived, that have been subsequently covered by water due to rising sea levels or other phenomena.

Importance



Titanic

There are many reasons why underwater archaeology can make a significant contribution to our knowledge of the past. Some individual shipwrecks are of significant historical importance either because of the magnitude of loss of life (such as the Titanic) or circumstances of loss (*Housatonic* was the first vessel in history sunk by an enemy submarine). Shipwrecks (such as The Mary Rose) can also be important for archaeology because they can form a kind of accidental time capsule, preserving an assemblage of human artifacts at the moment in time when the ship was lost.

Sometimes it is not the wrecking of the ship that is important, but the fact that we have access to the remains of it, especially where the vessel was of major importance and significance in the history of science and engineering (or warfare), due to being the first of its type of vessel. The development of submarines, for example, can be traced via underwater archaeological research, via the *Hunley* which was the first submarine to sink an enemy ship (*Hunley* also had unique construction details not found in previous vessels and was one of the only historic warships ever raised intact), the Resurgam II, the first powered submarine, and Holland 5, which provides insight into the development of submarines in the British Navy;

Underwater archaeology is often complementary to archaeological research on dry sites because materials are preserved differently under water than on dry sites on land. In anaerobic, cold and dark conditions underneath waterlogged sediments, organics, such as plants, leather, fabric and wood may be preserved as on *Hunley* and *Mary Rose*. These materials may still have evidence of how they were worked, such as tool marks on the surface of wood. This evidence can provide new insights into ancient crafts, cultures and lifestyles.

Underwater archaeology is not just about shipwrecks. Changes in sea-level, because of local seismic events, such as the earthquakes that devastated Port Royal and Alexandria, or more widespread climatic or changes on a continental scale mean that some sites of human occupation that were once on dry land are now submerge. At the end of the last ice age the North Sea was a great plain, and anthropological material, as well as the remains of animals such as mammoths are sometimes recovered by trawlers. Also, because human societies have always made use of water, sometimes the remains of structures that these societies built underwater still exist (such as the foundations of crannogs, bridges and harbors) when traces on dry land have been lost.

Challenges

Underwater sites are inevitably difficult to access, and more hazardous, compared with working on dry land. In order to access the site directly, diving equipment and diving skills are necessary. The depths that can be accessed by divers, and the length of time available at depths, are limited. For deep sites beyond the reach of divers, submarines or remote sensing equipment are needed.

For a marine site, some form of working platform (typically a boat or ship) is needed. This creates logistics problems. A working platform for underwater archeology needs to be equipped to provide for specialist remote sensing equipment, analysis of archaeological results, support for activities being undertaken in the water, storage of supplies, facilities for conservation for any items recovered from the water, as well as accommodation for workers. Equipment used for archaeological investigation, including water dredge and air lifts create additional hazards and logistics issues. Moreover, marine sites may be subject to strong tidal flows or poor weather which mean that the site is only accessible for a limited amount of time.

Underwater sites are often dynamic, that is they are subject to movement by currents, surf, storm damage or tidal flows. Structures may be unexpectedly uncovered, or buried beneath sediments. Over time, exposed structures will be eroded, broken up and scattered. The dynamic nature of the environment may make in-situ conservation infeasible, especially as exposed organics, such as the wood of a shipwreck, are likely to be consumed by marine organisms such as piddocks. In addition, underwater sites can be chemically active, with the result that iron can be leached from metal structures to form concretions. The original metal will then be left in a fragile state. Artifacts recovered from underwater sites need special care.

Visibility may be poor, because of sediments or algae in the water and lack of light penetration. This means that survey techniques that work well on land (such as triangulation), generally can not be used effectively under water.

In addition it can be difficult to allow access to the results of the archaeological research as underwater sites do not provide good outreach possibilities or access for the general public. Work has been done to bridge this difficulty with the excavation of the *Queen Anne's Revenge*

Techniques

An important aspect of project design is likely to be managing the logistics of operating from a boat and of managing diving operations. The depth of water over the site, and whether access is constrained by tides, currents and adverse weather conditions will create substantial constraints on the techniques that can feasibly be used and the amount of investigation that can be carried out for a given cost or in a set timescale.

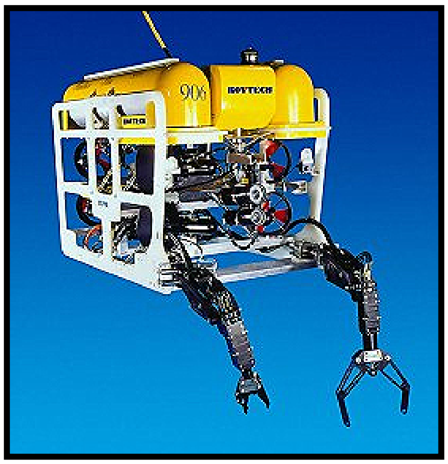
As with archaeology on land, some techniques are essentially manual, using simple equipment (generally relying on the efforts of one or more scuba divers), while others use advanced technology and more complex logistics (for example requiring a large support vessel, with equipment handling cranes, underwater communication and computer visualization).

Position Fixing

Knowing the location of an archaeological site is fundamental to being able to study it. In the open sea there are no landmarks, so position fixing is generally achieved using GPS. Historically, sites within sight of the shore would have been located using transects. A site may also be located by visually surveying some form of marker (such as a buoy) from two known (mapped) points on land. The depth of water at a site can be determined from charts or by using the depth sounding sonar equipment that is standard equipment on ships. Such sonar can often be used to locate an upstanding structure, such as a shipwreck, once GPS has placed the research vessel in approximately the right location.

Site Survey

The type of survey required depends on the information that is needed to resolve archaeological questions, but most sites will need at least some form of topographical survey and a site plan showing the locations of artifacts and other archaeological material, where samples were taken and where different types of archaeological investigation were carried out. Environmental assessment of archaeological sites will also require that environmental conditions (water chemistry, dynamic properties) as well as the natural organisms present on the site are recorded. For shipwrecks, particularly post-industrial age shipwrecks, pollution threats from wreck material may need to be investigated and recorded.



The simplest approach to survey is to carry out three dimensional surveying by divers using depth gauges and tape measurements. Research shows that such measurements are typically less accurate than similar surveys on land. Where it is not practical or safe for divers to physically visit a site, Remotely Operated Vehicles (ROVs) enable observation and intervention with control by personnel located at the surface. The low technology approach of measuring using tape measures and depth gauges can be replaced with a more accurate and quicker high technology approach using acoustic positioning.

Remote sensing or Marine Geophysics is generally carried out using equipment towed from a vessel on the surface and therefore does not require any one, or any equipment to actually penetrate to the full depth of the site. Sensitive sonar, especially side-scan sonar or multi-beam sonar may be used to image an underwater site. Magnetometry can be used to locate metal remains such as metal shipwrecks, anchors and cannons. Sub-bottom profiling utilizes sonar to detect structures buried beneath sediment.

Recording

A variety of techniques are available to divers to record findings underwater. Scale drawing is the basic tool of archaeology and can be undertaken underwater. Pencils will write underwater on permatrace, plastic dive slates, or matt laminated paper.

Photography is the mainstay of recording and with the advent of digital cameras is cheap and convenient. For underwater use, cameras, including video cameras can be provided with special housings that enable them to be used underwater. Low visibility underwater and distortion of image due to refraction mean that perspective photographs can be difficult to obtain. However, it is possible to take a series of photographs at adjacent points and then combined into a single photomontage or photomosaic image of the whole site.

Excavation

Where intrusive underwater excavation is appropriate, silts and sediments can be removed from an area of investigation using a water dredge or airlift. When used correctly, these devices have an additional benefit in tending to improve the visibility in the immediate vicinity of the investigation. It is also important to note that for very deep sea excavation submarines are sometimes used to view sites. Underwater photography can also be conducted from these submarines which assists the recording process.

Archaeological science

A variety of archaeological sciences are used in underwater archaeology. Dendrochronology is an important technique especially for dating the timbers of wooden ships. It may also provide additional information, including the area where the timber was harvested (i.e. likely to be where the ship was built) and whether or not there are later repairs or reuse of salvaged materials. Because plant and animal material can be preserved underwater, archaeobotany and archaeozoology have roles in underwater archaeology. For example, for submerged terrestrial sites or inland water, identification of pollen samples from sedimentary or silt layers can provide information on the plants growing on surrounding land and hence on the nature of the landscape. Information about metal artifacts can be obtained through X-ray of concretions. Geology can provide insight into how the site evolved, including changes in sea-level, erosion by rivers and deposition by rivers or in the sea.

Artifact recovery and conservation

Artifacts recovered from underwater sites need stabilization to manage the process of removal of water and conservation. The artifact either needs to be dried carefully, or the water replaced with some inert medium (as in the case of The Mary Rose). Artifacts recovered from salt water, particularly metals and glass need be stabilized following absorption of salt or leaching of metals. In-situ conservation of underwater structures is possible, but consideration needs to be given to the dynamic nature of the site. Changes to the site during intrusive investigation or removal of artifacts may result in scouring which exposes the site to further deterioration.

Activity: Mock Shipwreck: A Lesson in Maritime Archaeology

Students, equipped with a slate, compass, and measuring tape, begin their journey down the imaginary anchor line to the shipwreck awaiting them on the Lake Bottom or seabed. They have left the realm of their classroom to become underwater archaeologists, sent to document the history entombed within our country's vast collection of shipwrecks. Like professional underwater archaeologists in the field, the "dive" team communicates only by hand signals, taught to them just moments before. They begin their detailed sketches of the mock shipwreck that lie across the classroom floor.

A vessel filled with artifacts will be located in the underwater archaeological site, but it is easy for students to envision an intact shipwreck filled with artifacts from centuries past. Each student has a role, and the team works together to discover the mysteries that this time capsule holds. By putting archaeological techniques into practice, these students advance their math, science, and problem solving skills, as well as delve into historic research. Through simulated archaeological and historic research, students solve the mysteries surrounding the wreck site: What ship is it? Who sailed her? How did she sink? What role did she play in our maritime heritage?

This underwater archaeology heritage-based lesson plan generates excitement among students and peaks their curiosity about the people who lived and worked along our coasts and the events that shaped who we are today. Activities like this offer experiences and information that help make the past real for participants.

Materials

Log Sheet to record wreck measurements and observations

- Mock shipwreck (set up in the classroom, on the lawn or beach!)
- Measuring tape or 50 ft of nylon line
- Measuring tape, clipboard, ruler, graph paper, pencils and paper for each group of three to four students
- Reference sheets

Preparation

Prior to students entering the room put together a mock shipwreck with canvas, plastic, or materials from the classroom.

This activity is based on the survey technique that archaeologists use underwater to document a shipwreck. Imagine finding a shipwreck. Because the site of the wreck presents a mystery to the beholder, the first questions usually asked are basic:

- What kind of ship was this?
- How was it used?
- Why is it resting in its present location and position?

For thousands of years when a shipwreck was found, the first thought was to use anyway possible to salvage all items or artifacts (portable objects that have been modified, shaped or utilized by humans) of value (gold, jewels, ceramics, cannons, engine parts, etc.). Separating these items from the ship separated them from their history, thus diminishing the monetary value of the treasure. In addition, the moment in time when the disaster occurred is forever lost as the pieces of the puzzle are removed creating holes in the puzzle, preventing the entire story from ever being told. To be able to piece together the puzzle remains, a team of maritime archaeologists must collect data and create a detailed drawing of the wreck called a “site plan”. Some ships, once documented, have been compared to original ship design plans to determine the changes taken place over time on the wreck site. However, often times the original plans are not available, but by creating a plan of the ship you can study the choices for materials and construction that explain the needs of the time from which the vessel originated.

The technique most commonly used by archaeologists to develop a site plan is called triangulation. This is a simple form of survey by measuring horizontally from two known points to a third, and then producing a scale drawing using a compass to draw an arc from each measured point on graph paper at the distance measured on the wreck. Where the two arcs intersect gives the plotted position of the third point. Accuracy is increased if the measurements are taken from three known points because survey or drawing errors become more apparent. Martin, Dean. 1988. “Guidelines on Acceptable Standards in Underwater Archaeology”

Tell students that archaeologists are like detectives. They search for evidence and analyze clues to reach a conclusion. Students will not only use the triangulation technique to draw site plan, put they will use their deductive reasoning skills to answer questions about the wreck specific to their observations. To thoroughly understand some of these concepts, please visit the following website resources for reference:

- http://www.cyberpursuits.com/archeo/uw-arch.asp
- http://www.culture.gouv.fr/culture/archeosm/en/
- http://www.pophaus.com/underwater

Learning Procedure

1. Define for the students archaeology, and the difficulties of working on a site underwater (time limit, lack of communication and variable sea states). Explain how each group must work in teams to document the site, and then have them record general observations as they take their first “dive”. Pass out the log sheet provided for the student groups to record the observations and dive information. Also, remind them that they are divers without any communication gear and cannot talk to one another. Provide each student with the international diver hand signal sheet for their reference to review while preparing for their dive. However, often times wreck sites have low visibility making it difficult to communicate. Explain to the students that they must communicate with their compasses, measuring tape, hand signals and drawing slates. Make sure each student group creates a dive plan before diving to the mock wreck site (entering the classroom).

A dive plan is developed to ensure all members of the dive party understand what the goals of the dive will be before the dive, and to ensure that all dives are safely conducted. This is an important concept to relay to the students. All dives are limited by time, the depth of their dive, and the air in their tank. All of the students should understand each of their roles when planning their “dive” to the site. So, if miscommunication occurs while on the site the dive can be called because the plan has not been followed. This is a good section used to teach teamwork and communication skills.

2. COMMUNICATION-each student on the team has a role to play. The first student records; another is in charge of the “zero” end of the measuring tape, or the end where the units of measurement begin; the third student is the “measure” end of the tape, or the end where the numbers increase. The measure end is also in charge of the tape and communication. The recorder is always next to the smart end writing the information down as each point is measured. One pull of the tape means to move to the next measurement, while two pulls of the tape means to come to the smart end for discussion. If there is a fourth team member, he/she will become the site planner to make sure the original dive plan is being followed. The planner has the ultimate decision to call (stop) the “dive” if it is not according to the original plan set before the project began.

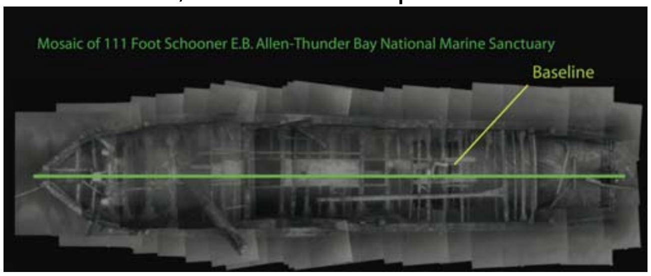
3. Demonstrate triangulation techniques off a set baseline to a mock shipwreck set up in the classroom. Show the students how to take their work back to their desks (most likely the next day) to develop a scaled site plan of the wreck site. Please refer to the TRIANGULATION info sheet to teach this concept.

4. Have the students take each point and fill them in on their log sheet. Make sure the students measure to the middle of something small to make a point, and then measure the size of the artifact for accuracy.

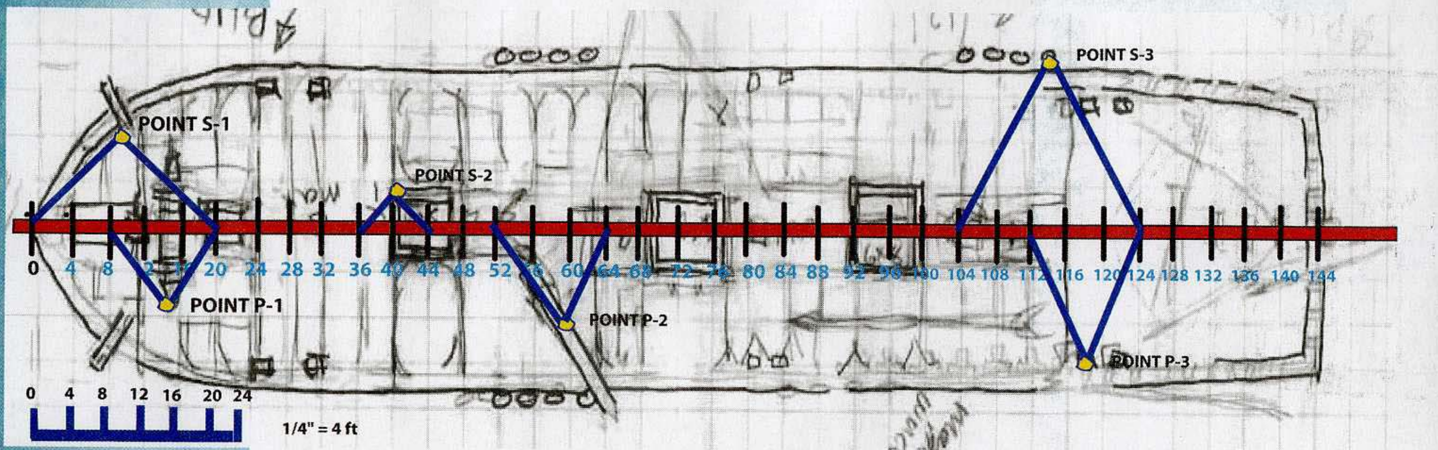
Have the students observe each of the hatches after they are measured. Are all of the hatches the same length? What might the holds beneath been used for? What might the ship have been carrying? Is there any evidence of cargo? Is the vessel sail or steam powered?

After all of the points are taken (the more points, the more accurate the ship site plan will be) have the students take their log sheet back to their desks to begin the development of their site plans. Students may develop individual site plans, or do it as a group from the data that they collected from the wreck site.

5. Lead a class discussion about each team’s observations. Have the students give a presentation on their site plans, their hypothesis on what might have happened, and how to protect the resource. Then, discuss the importance of preserving shipwrecks, and the significant roles that archaeologists play in re-telling the stories of our maritime past through submerged maritime heritage resources. Have the student research famous shipwrecks, and have them lead discussions as a team as to how those stories might have been altered by natural or human effects.



Triangulation



After creating a baseline on the shipwreck, have students decide what their scale will be on their graph paper. The wreck shown here is a 1/4" = 4 ft scale. The blue lines are the measurements taken from the baseline, and labled POINT S-1 for the right(starboard)side of the ship, and POINT P-2 for the left(port) side. Have the students take each point and fill them into their log sheet.

Make sure the students measure to the middle of something small (like a deadye) to make a point, and then measure the size of the artifact for accuracy. If their is a square feature (like a hatch) measure to all four corners from the same place on the baseline.

For example:

POINT S-2- Taken from 36 ft and 44 ft on the base line. The top left hand corner of the forehatch is 4.5 ft from each point on the baseline. Repeat process for each corner.

Have the students observe each of the hatches after they are measured. Are all of the hatches the same length? What might the holds beneath been used for? What might the ship have been carrying? Is there any evidence of cargo?

After all of the points are taken (the more points, the more accurate the ship site plan will be) have the students take their log sheet back to their desks to begin the development of their site plans.

Make sure each student has a compass, piece of graph paper, ruler and pencils. They may each develop a site plan, or do it as a group from the data that they collected from the wreck site.

Lay out a baseline on the graph paper similar to that on the mock shipwreck. Begin plotting points from the log sheets using a compass. The point is plotted where the arcs intersect from each of the baseline measurements. Connect related points and draw in features.

NATIONAL MARINE SANCTUARIES ™
—& Underwater Preserve—
THUNDER BAY

Underwater Archaeology

Log Sheet

SITE NAME____

DATE____

OBSERVER NAME____

TIME OF DIVE____

SITE ORIENTATION____

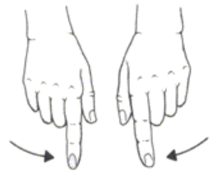
DEPTH____

SITE
DESCRIPTION____
____
____
____
____
____
____
____

Draw a Picture of your archaeological site

International Dive Signals


Ok


Stay together

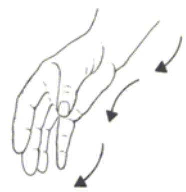

Let's go down (descent)

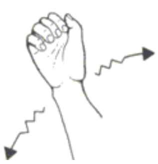

Let's go up (ascent)

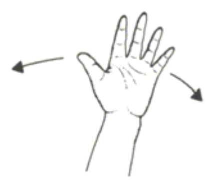

Short of breath


Calm down


Something is wrong

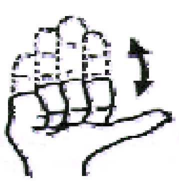

Fish

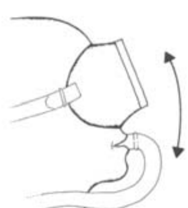

I am freezing


Danger

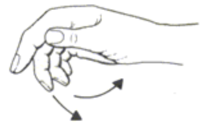

Stop

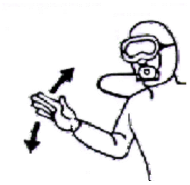

Point to something


Taring

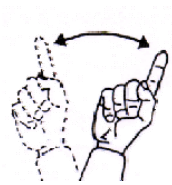

Yes

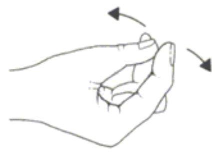

Out of Air

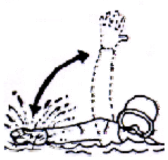

Come to me

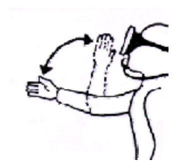

Slow down


Low on Air


No

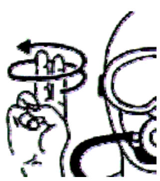

I do not understand


Distress Signal on the surface


Direction

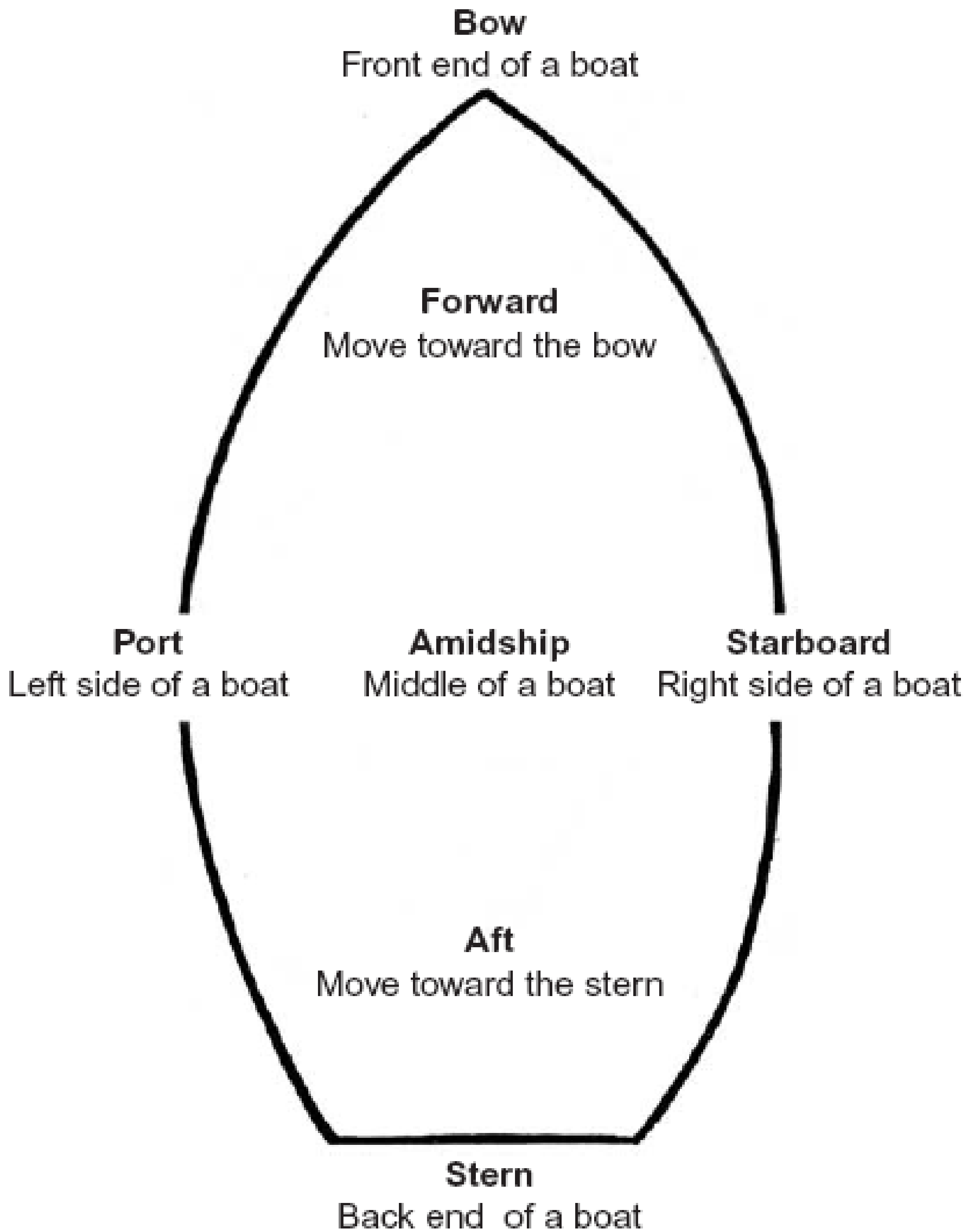

Faster

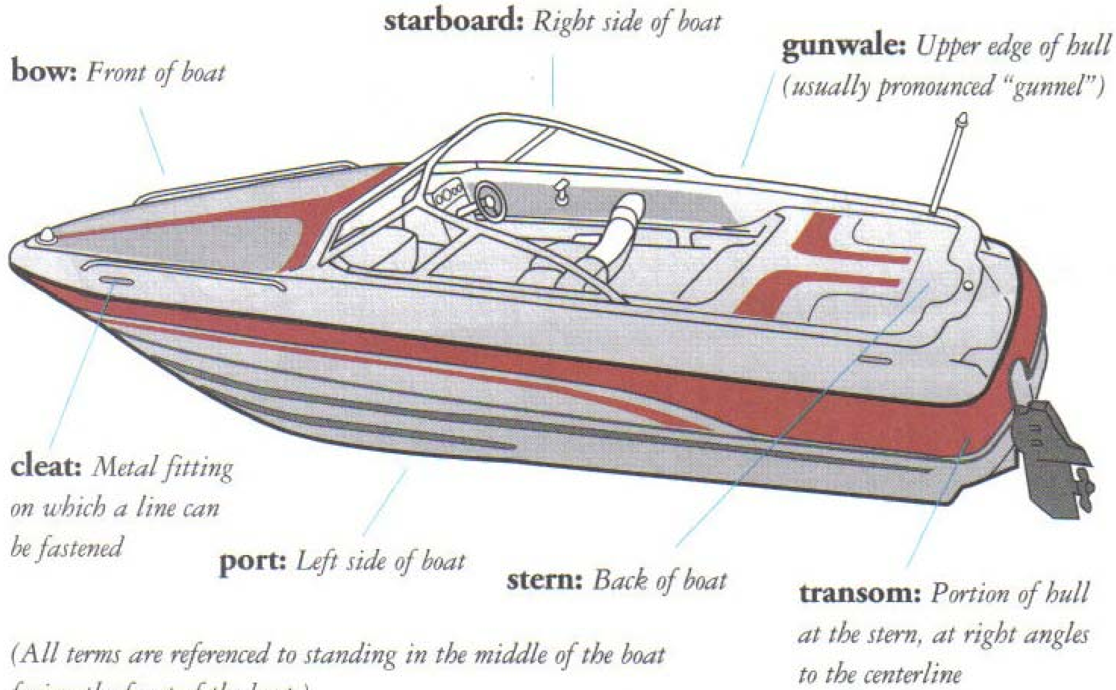

Cramp in the calf


Giddiness

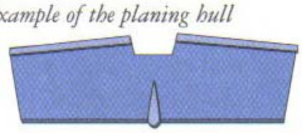
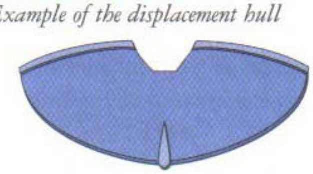

Regulator blow off

Directions on Boats





(All terms are referenced to standing in the middle of the boat facing the front of the boat.)

Hull Shapes	Advantages	Disadvantages
Flat Bottom Hull *Example of the planing hull* 	Has a shallow draft and is relatively stable. Good for fishing in small lakes and rivers. They are usually the least expensive to build.	Provides a rough ride and tends to pound in choppy water.
Deep Vee Hull *Variation of the planing hull* 	Gives good stability and less pounding in rough water than other designs.	Takes more power to move at the same speed as flat bottom hulls. May roll or bank in sharp turns.
Round Bottom Hull *Example of the displacement hull* 	Moves easily through the water offering a slow but comfortable ride.	Has a tendency to roll.
Multi-Hull *Example of two hulls joined* 	The multi-hull has greater stability because of its wide beam.	Needs a large area when turning.