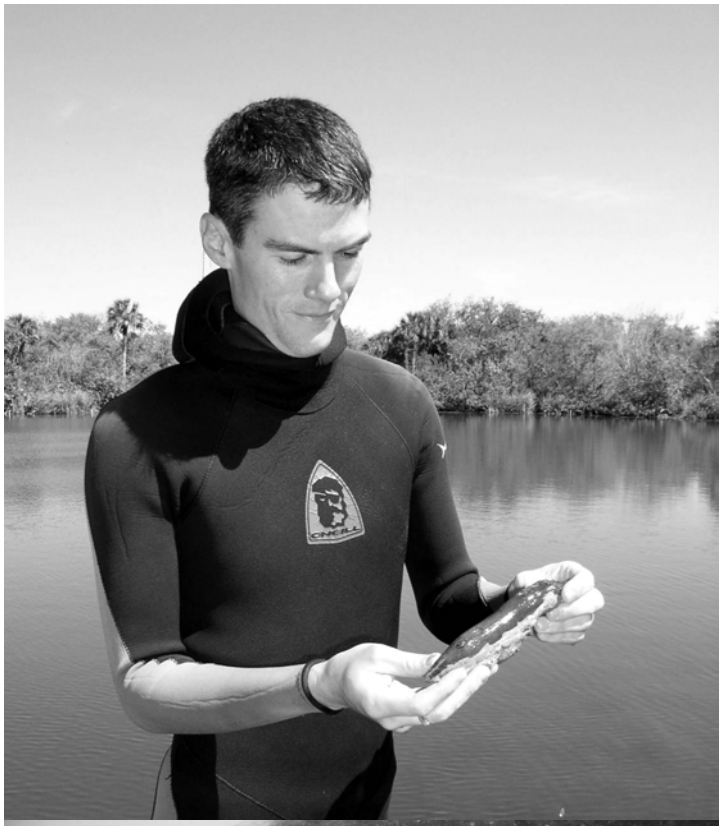

THE FLORIDA AQUARIUM™

Underwater Archaeology Curriculum Project

Project generously sponsored by the Dorr Foundation.

The Florida Aquarium's Underwater Archaeology Program

The Florida Aquarium has launched an Underwater Archaeology program through two projects that will expand our understanding of Florida's settlement and development: 1) An underwater survey of Tampa Bay, the only major Florida port with a long maritime history that has never been surveyed for submerged cultural material; and 2) An investigation with the University of Miami of a prehistoric settlement at Little Salt Spring. The Underwater Archaeology initiative is designed to bring these discoveries as well as the process of scientific investigation to the public. The Aquarium plans to complement this project with educational programming for the public.

Acknowledgments

The Dorr Foundation generously funded this curriculum project. The project includes a multidisciplinary curriculum for middle and high school students, a series of teacher education workshops, and online media opportunities.

The Underwater Archaeology Curriculum Project is designed for grades 7-10, although lessons may be adapted for younger or older grade levels. Florida Sunshine State Standards for 5th, 8th, and 10th grades are included for each lesson.

This curriculum was developed by Cristina Bonilla-Warford and the Florida Aquarium Education Department with assistance from Debra Keith (Hillsborough County Schools).

Many people gave valuable feedback on the lessons plans and content, without whom this project would not have been possible. Thank you to:

- Debbi Stone, Vice President of Education, The Florida Aquarium
- Debra Keith, Science Subject Area Leader, Rodgers Middle School
- Luisella DeAngelis, Teacher Programs Coordinator, The Florida Aquarium
- Dr. John Gifford, University of Miami
- John W. Morris, Southeastern Archaeological Services
- Casey Coy, Director of Dive Operations & Dive Safety Officer, The Florida Aquarium
- Mike Terrell, Dive Training Coordinator, The Florida Aquarium
- M. Nicole Tumbleson, Outreach Coordinator, Florida Public Archaeology Network
- Cassandra Rae Harper, Outreach Coordinator, Florida Public Archaeology Network
- Dr. Terrie Nolinske, TNI Consultants LLC
- And many others…

Photos courtesy of the Florida Aquarium. Original Illustrations by Kevin Stone, Stone Designs

For more information about the Florida's Aquarium's Underwater Archaeology projects and for information about the Florida Aquarium's Education programs, please visit www.flaquarium.org

10/9/08: Program sponsored by the Dorr Foundation, with curriculum review currently in process with the South Eastern Archaeological Services and the University of Miami.

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Sunshine State Standards

Science Standards

SC.C.1.3.2 Wave energy The student knows that vibrations in materials set up wave disturbances that spread away from the source (e.g., sound and earthquake waves).

SC.C.2.3.1 Forces The student knows that many forces (e.g., gravitational, electrical, and magnetic) act at a distance (i.e., without contact).

SC.D.2.3.2 Consequences of Human Action The student knows the positive and negative consequences of human action on the Earth's systems.

SC.G.1.2.2 Adaptations and competition The student knows that living things compete in a climatic region with other living things and that structural adaptations make them fit for an environment.

SC.G.1.2.7 Environmental influences The student knows that variations in light, water, temperature, and soil content are largely responsible for the existence of different kinds of organisms and population densities in an ecosystem.

SC.G.2.3.3 Resources and population The student knows that a brief change in the limited resources of an ecosystem may alter the size of a population or the average size of individual organisms and that long-term change may result in the elimination of animal and plant populations inhabiting the Earth.

SC.H.1.2.1 Record keeping The student knows that it is important to keep accurate records and descriptions to provide information and clues on causes of discrepancies in repeated experiments.

SC.H.1.2.2 Observation and analysis The student knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results.

SC.H.1.2.3 Working collaboratively The student knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions.

SC.H.1.2.4 Compare and contrast The student knows that to compare and contrast observations and results is an essential skill in science.

SC.H.1.2.5 Models The student knows that a model of something is different from the real thing, but can be used to learn something about the real thing.

SC.H.1.3.1 Knowledge changes The student knows that scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way.

SC.H.1.3.2 Understand the inquiry process The student knows that the study of the events that led scientists to discoveries can provide information about the inquiry process and its effects.

SC.H.1.3.3 Science shares common goals The student knows that science disciplines differ in topic, techniques, and outcomes, but they share a common purpose, philosophy, and enterprise.

SC.H.1.3.4 Record keeping The student knows that accurate record keeping, openness, and replication are essential to maintaining an investigator's credibility with other scientists and society.

SC.H.1.3.5 Variables The student knows that a change in one or more variables may alter the outcome of an investigation.

SC.H.1.3.6 Diversity in Science The student recognizes the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations

Sunshine State Standards

SC.H.1.4.3 Theories change The student understands that no matter how well one theory fits observations, a new theory might fit them as well or better, or might fit a wider range of observations, because in science, the testing, revising, and occasional discarding of theories, new and old, never ends and leads to an increasingly better understanding of how things work in the world, but not to absolute truth.

SC.H.2.3.1 Patterns The student recognizes that patterns exist within and across systems.

SC.H.3.2.1 Tools to solve problems The student understands that people, alone or in groups, invent new tools to solve problems and do work that affects aspects of life outside of science.

SC.H.3.2.2 Importance of data The student knows that data are collected and interpreted in order to explain an event or concept.

SC.H.3.2.4 Forming new ideas The student knows that through the use of science processes and knowledge, people can solve problems, make decisions, and form new ideas.

SC.H.3.2.4 Problem solving The student knows that through the use of science processes and knowledge, people can solve problems, make decisions, and form new ideas

SC.H.3.3.1 Ethical concerns The student knows that science ethics demand that scientists must not knowingly subject coworkers, students, the neighborhood, or the community to health or property risks. (Also assesses H.3.3.2 and H.3.3.3)

SC.H.3.3.6 Knowledge available universally The student knows that no matter who does science and mathematics or invents things, or when or where they do it, the knowledge and technology that result can eventually become available to everyone.

SC.912.N.1.1 Scientific investigation Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following:

1. pose questions about the natural world,
2. conduct systematic observations,
3. examine books and other sources of information to see what is already known,
4. review what is known in light of empirical evidence,
5. plan investigations,
6. use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs),
7. pose answers, explanations, or descriptions of events,
8. generate explanations that explicate or describe natural phenomena (inferences),
9. use appropriate evidence and reasoning to justify these explanations to others,
10. communicate results of scientific investigations, and
11. evaluate the merits of the explanations produced by others.

Sunshine State Standards

Language Arts Standards

L A.7.5.2.2 Persuasive speech The student analyzes persuasive techniques in both formal and informal speech.

LA.7.4.2.2 Visual aids to organize info The student will record information (e.g., observations, notes, lists, charts, legends) related to a topic, including visual aids to organize and record information, as appropriate, and attribute sources of information;

LA.7.5.2.1 Listening strategies The student uses effective listening strategies for informal and formal discussions, connecting to and building on the ideas of a previous speaker and respecting the viewpoints of others when identifying bias or faulty logic.

LA.7.5.2.3 Organize and give persuasive speech The student organizes and effectively delivers speeches to entertain, inform and persuade, demonstrating appropriate language choices, body language, eye contact, gestures, and the use of supporting graphics and technology.

LA.910.3.5.2 Using graphics/design principles The student will include such techniques as principle of design (e.g., margins, tabs, spacing, columns) and graphics (e.g., drawings, charts, graphs)

Mathematics Standards

MA.4.G.5.3 Two-dimensional representation Identify and build a three dimensional object from a two-dimensional representation of that object and vice versa

MA.5.G.5.3 Measurement Solve problems requiring attention to approximation, selection of appropriate measuring tools, and precision of measurement.

Social Studies Standards

SS.A.1.3.1 Interpreting Events The student understands that historical events are subject to different interpretations.

SS.A.2.3.4 Geographical factors The student understands the impact of geographical factors on the historical development of civilizations.

SS.A.2.4.1 Early humans The student understands the early physical and cultural development of humans.

SS.B.1.3.1 Using map forms The student uses various map forms to acquire information (for example, location, distance, direction, scale, symbol).

SS.B.1.4.2 Comparing maps The student understands the advantages and disadvantages of using maps from different sources and different points of view.

SS.B.2.3.7 Environmental conditions The student knows how various human systems have developed in response to conditions in the physical environment.

Module 1: What is Archaeology?

Introduction

Archaeology is the study of human past through its material remains (artifacts). An artifact is any tool, implement, or object manufactured or modified by humans. The objectives of archaeology are to construct cultural history, reconstruct past life ways, and study cultural processes. Culture is a shared set of beliefs and behaviors that help mold one's responses to different situations. By studying artifacts, we can learn about the people who made and used those artifacts.

Many people collect stone tools, pottery or other artifacts made by prehistoric people. But archaeologists look for more than just the artifacts themselves. They analyze the artifacts (size, shape, materials, how it was made, etc.) as well as the context the artifacts were found in (how deep, what other artifacts are nearby, etc.) in order to recreate a story about where and how the artifact was created or used. Context gives artifacts their meaning. It is not the individual object or feature that tells the story. It is the whole process of how it came to be where it was buried.

Archaeologists use their experience and knowledge of history and culture to draw conclusions about new artifacts, sites, and cultures. They must be open-minded, not to impose their cultural beliefs when interpreting other cultures. Archaeologists use the skills of observation and inference. Observation is the act of recognizing and noting a fact or occurrence, often involving objective measurement. Inference is a conclusion derived from observations, base on our past experiences and knowledge. Archaeologists must use both observations and inferences to determine the origin, context, or culture of artifacts.

The archaeological process often includes: site location, site excavation, artifact identification/ examination, interpretation of findings, preservation of artifacts and site, and sharing information with others. Excavation is the method that archaeologists use to extract artifacts out of the ground. The work is very difficult and has to be detail-oriented since the archaeologist is destroying the very thing he/she is trying to study – and there are no "do-overs". It is also impossible for the archaeologist to know exactly what is under the ground, so he/she has to be very careful not to damage artifacts they cannot see while excavating other artifacts.

Underwater, the process of archaeology is more challenging, but can provide information not available in terrestrial archaeological sites, as will be discussed in Module 2. The logistics of underwater archaeology are discussed in Lesson 1-3.

Resources:

Florida Anthropological Society. Florida Archaeology: An Overview

Harper, Cassandra Rae. Florida Public Archaeology Network. Beyond Artifacts: Teaching Archaeology in the Classroom. 2007.

Lesson 1-1: What is Archaeology?

Time Allotment
20 minutes

Materials
Per student:
- One penny
- Observations and Inferences activity sheet

Advance Preparation
Make copies of the activity sheet.

Students will work in groups of 2 or 3.

Lesson Objectives
- Define "archaeology", "artifact", "observation" and "inference".
- Record observations and inferences of modern day artifacts (coins).
- Discuss how archaeologists analyze artifacts to draw conclusions about cultures.

Sunshine State Standards
SC.H.1.2.1 Record keeping
SC.H.1.2.2 Observation and analysis
SC.H.1.3.1 Knowledge changes
SC.H.1.3.3 Science shares common goals
SC.H.1.3.4 Record keeping
SC.H.1.4.3 Theories change
SS.A.1.3.1 Interpreting Events

Vocabulary
Archaeology
Artifact
Culture
Inference
Observation

Initial Discussion
1. Write the word "archaeology" on the board and ask students to share with a partner what the word means and what they think archaeologists do.

2. Collect verbal responses from different students and help them analyze for similarities, differences, myths, and misconceptions. Write the complete definition on the board. Discuss.

3. Define **archaeology** as the study of human past through its material remains (artifacts).

4. Define **artifact** as any tool, implement, or object manufactured or modified by humans. Define **culture**, a shared set of beliefs and behaviors that helps mold one's responses to different situations.

5. Explain that artifacts represent cultures. By studying artifacts we can learn about the people who made and use the artifacts.

6. Discuss how when studying artifacts, we need to make sure we are starting with objective observations, before developing inferences from our cultural perspective.

Hands-On Activity
7. Briefly discuss the definitions of and differences between observation and inference. **Observation** is the act of recognizing and noting a fact or occurrence, often involving objective measurement. **Inference** is a conclusion derived from observations, base on our past experiences and knowledge.

8. Organize students into groups of 2-3. Hand out pennies, one per student. Challenge students to work together to create a list of at least 15 observations of the coins on the Observations and Inferences sheet.

9. Have groups compare and contrast the different pennies. Pennies of different ages may show different characteristics that cannot be seen in examining a single penny.

10. Help students to identify observations that might actually be inferences. For example, we can infer that the image on the front of the penny was an important person, but the observation is that there is a profile of a bearded man on the one side of the penny.

11. Review the lists as a class. Challenge students to use their observations to create a list of at least 10 inferences about the culture that created the coins. Discuss.

Lesson 1-1: What is Archaeology?

Relate Activity to Concept

12. Ask students to imagine that in 1,000 years, all that was left of our culture were metal objects. What objects would be left? What would future archaeologists be able to observe about our culture?

13. The further we go back in time, the fewer artifacts are left to find. In many archaeological sites, we find stone and metal objects, but few wood, fur, or fabric items because they have decomposed or deteriorated over time.

14. Archaeologists must recognize that only a small percentage of a culture's artifacts may remain and they have to uses skills of observation and inference to piece together a story of the culture. They must use their experience and knowledge of history and culture to draw conclusions about new artifacts from another culture.

15. In later lessons, students will need to remember to recognize observations from inferences in order to be open-minded about new cultures.

Assessment

Collect the activity sheets for grading.

Modifications/ Extensions

Students can design a coin from an invented culture. Have groups design and describe at least 5 design elements that represent beliefs from their invented culture. Students should draw both sides of their coin, enlarged to show detail. Then groups can trade coin designs and practice making observations and inferences about the coins. After groups have made observations and hypotheses about the coin, they can trade their descriptions to learn the ideas behind the coins.

Use foreign currency. By using an unfamiliar coin, students will have no preconceived notions of what the symbols and pictures on the coin mean.

Adapted from:

- "Observation and Inference" Smith, Shelley J., Jeanne M. Moe, Kelly A. Letts, Danielle M. Patterson. *Intrigue of the Past: A Teacher's Activity Guide for Fourth through Seventh Grades.* U.S. Dept of the Interior, Bureau of Land Management. 1993
- "Questioning Artifacts" National Park Service, Alcatraz Island-Golden Gate Park, www.nps.gov/goga/forteachers/upload/Questioning_Artifacts_curriculum.pdf
- Durbin, Gail, et al., "A Teacher's Guide to Learning from Objects", 1990.

What can you see in a penny?

Name: _____

Observations	Inferences
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
11.	
12.	
13.	
14.	
15.	

What can you see in a penny?

Name: _____

TEACHER EXAMPLES

Observations	Inferences
1. Coin is made of metal. →	1. People have access to metal, perhaps through mining.
2. There is a face of a bearded man on one side of the coin. →	2. The man on the coin was important to the culture somehow – and/or – men wore facial hair.
3. There are numbers on the coin – the people had a numerical system. →	3. The numbers represent a date, perhaps an important year or the year the coin was made.
4. Words on the coin state "In God We Trust". →	4. People believed in a deity, perhaps they were deeply religious.
5. A building with columns is represented on the coin. →	5. The building is an important place – built as a monument or gathering place.
6. Words on the coin "E Pluribus Unum" are from the Latin language. →	6. The people spoke both English and Latin.
7. The object is small enough to be carried. →	7. People may have carried many coins.
8. Words on the coin "United States of America" signify a group of states.→	8. People in all states may have used the same coins.
9.	9.
10.	10.

Lesson 1-2: How to Read an Artifact

Time Allotment
30-40 minutes

Materials
Initial Discussion:
- An unfamiliar object (see ideas below)
- How to Read an Artifact transparency

Per group:
- An unfamiliar object (see ideas below)
- Artifact Images

Per student:
- How to Read an Artifact activity sheet (double-sided – 2 per student)

Advance Preparation
Collect objects that may be unfamiliar to students or difficult to identify, such as unusual kitchen utensils, tools, toys, or a broken piece of a bigger object.

Make copies of the activity sheets.

Students will work in groups of 4-5.

Lesson Objectives
- Use key questions to better observe, analyze, and infer uses of objects.
- Record observations and inferences of modern day and/or unfamiliar artifacts.
- Analyze artifacts found at Little Salt Spring and develop questions and hypotheses about the uses of the artifacts.
- Discuss how archaeologists analyze artifacts to draw conclusions about cultures.

Sunshine State Standards
SC.H.1.2.2 Observation and analysis
SC.H.1.3.1 Knowledge changes
SC.H.3.2.1 Tools to solve problems
SC.H.3.2.2 Importance of data
SC.H.3.2.4 Forming new ideas
SS.A.1.3.1 Interpreting Events

Vocabulary

Artifact	Inference
Culture	Observation

Initial Discussion
1. Show students the first unfamiliar object. Project the How to Read an Artifact transparency (or write some of the questions on the board).

2. Go through the questions and help students determine the objects' functions.

3. Explain that there are many questions we can use to analyze objects and infer uses of the object. In this activity, students will use questioning to learn more about different modern-day and pre-historic artifacts.

Hands-On Activity #1
4. Arrange students in groups of 4-5. Give each group different object, and each student an activity sheet. Allow students 5-10 minutes to visually and physically examine their objects. They should use the activity sheet to develop a list of observations, inferences and questions.

5. Have each group present their hypothesis about their objects' function. They must present evidence and reasoning for their determination. Ask the class for questions or alternative ideas.

6. Discuss the students' responses to the activity. Did any students correctly infer the uses or identities of the objects? What questions were asked about the objects?

Hands-On Activity #2
7. Hand out images of artifacts from Little Salt Spring (one set per group) and additional activity sheets (one per student). The students will now analyze and make inferences about a set of artifacts found at Little Salt Spring.

8. Have students use the activity sheet to analyze the artifacts and develop a list of observations, inferences and questions.

Lesson 1-2: How to Read an Artifact

9. Discuss the class findings. What observations were made? What questions were asked about the artifacts? Did any students make inferences about use or purpose of any of the artifacts? What was their reasoning? Was there any additional information that would be helpful in identifying the artifacts?

Relate Activity to Concept

10. Compile a list of questions the students developed about the set of artifacts. Later in the unit, students will learn more about the culture that created these artifacts.

11. Share more information about the artifacts.

    a) **Artifact #12 – SHELL DIPPER** – Made by chipping away the outer layers of shell and grinding the shell with stone, this dipper would have been used like a modern ladle.

    b) **Artifact #16 – GREENSTONE PENDANT** – A rare Archaic trade items recovered from the spring, this pendant reflects the extensive trade networks that existed in the southeastern United States. Its rarity implies that this was a material of prestige value.

    c) **Artifact #24 – KNIFE BLADE** – This well-made knife blade was created during the Florida middle Archaic stage. While often simply called 'arrow heads', these were more than just projectile points; they were also used as spear tips, darts, knives, scrapers and wood working tools.

    d) **Artifact #27 – ATLATL HANDLE/ SPEAR THROWER HANDLE** – Atlatls were used to hold and throw wooden spears. This handle would have been attached to a small hooked piece of wood that would launch a longer spear.

12. Relate how it is important that archaeologists use both observational and inferential skills. They must use their experience and knowledge of history and culture to draw conclusions about new artifacts from another culture.

Assessment

Collect the activity sheets for grading.

Modifications/ Extensions

Have students bring objects from home.
You may choose to have them bring a personal object that represents their life, or you may them bring an object whose function is not immediately apparent.

Have each student write a description of the object (name, use, etc.) and place it in an envelope with their name on the front. Place the envelope and the object in a bag.

Have the students pass their object bags to another student for analysis. When they have completed the activity sheets, they may open the envelopes and read the true descriptions of the objects.

Adapted from:

- "Looking at an Object", University of North Carolina-Chapel Hill School of Education. www.learnnc.org/lp/pages/1013
- "Questioning Artifacts Curriculum" National Park Service, Alcatraz Island-Golden Gate Park. www.nps.gov/goga/forteachers/upload/Questioning_Artifacts_Curriculum.pdf.

How to Read an Artifact

Name: _____

QUESTIONS	OBSERVATIONS	INFERENCES
Physical Features: What does it look like? What does the surface look like? How big is it? What color is it? Is the object complete or broken? Is it worn? How? Has it been altered or mended?		
Construction: What is it made of? How was it made? Is it natural or manufactured? Does it have different parts?		
Design: Is it decorated? How? How was the design made? Is there writing on the object? What does the writing or design suggest about the object use?		

How to Read an Artifact

Name: _____

QUESTIONS	OBSERVATIONS	INFERENCES
Context & History: When was it made? Where was it made? Where was it used? Where was it found? Who owned it?		

General Questions:

How might this object been used? What evidence leads you to this conclusion?

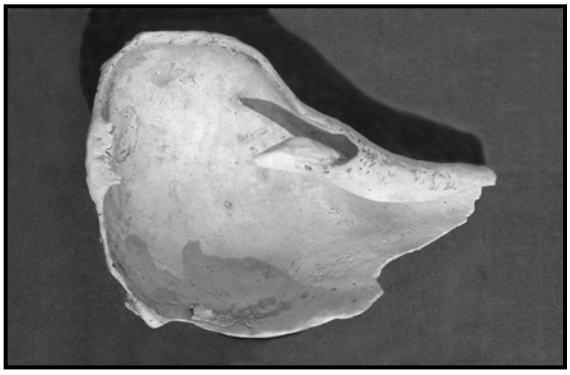
What kind of value might it have? What evidence leads you to this conclusion?
(monetary, spiritual, aesthetic, sentimental or practical)

How does the object reflect the culture at the time it was made?

What other information would be helpful to complete your analysis?

Little Salt Spring Artifacts

Name: _____

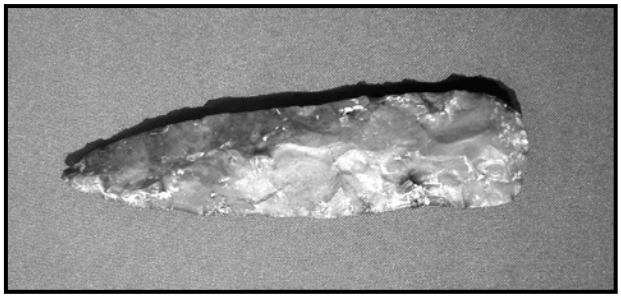


Artifact #12
Approx. 25 cm long; 15 cm wide

Found in Little Salt Spring. Dated to about 7,000 years ago. Made from a large conch shell. Shell edges were scraped smooth.

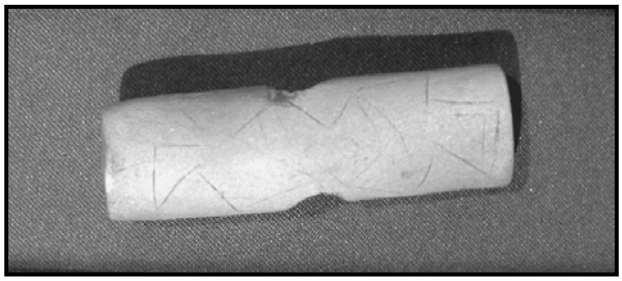
Artifact #16
5 cm long; 2 cm wide

Found in Little Salt Spring near artifacts dated to about 7,000 years ago. Smooth stone surface with a small hole drilled at the top of the stone. Made of greenstone, a type of stone not found in Florida, but found in Georgia and Alabama.



Artifact #24
15 cm long; 5 cm wide

Found in Little Salt Spring near artifacts dated to about 7,000 years ago. Sharpened chert stone with chipped edges.



Artifact #27
5 cm long; 2 cm wide

Found in Little Salt Spring. Dated to about 7,000 years ago. Made of deer antler with a cylindrical hole running through the center. A series of zigzag decorations was cut into both sides of its surface. Preserved wood was found in the hole, suggesting the hole was drilled to insert a piece of wood.

Lesson 1-3: Underwater Archaeologists

Time Allotment
30-50 minutes

Materials
Per student:
- Underwater Archaeology Articles
- Blank paper

Per group (optional – See Modifications):
- Underwater Archaeology Cards

Advance Preparation
Make copies of the articles.

Copy the Archaeology Cards and cut them out. Arrange them in sets.

Students should work in pairs or in small groups.

Lesson Objectives
- Read articles about underwater archaeology.
- Develop categories of characteristics of underwater archaeology.
- Compare and contrast underwater archaeology with terrestrial archaeology.

Sunshine State Standards
SC.D.2.3.2 Consequences of Human Action
SC.H.1.3.1 Knowledge changes
SC.H.1.3.6 Diversity in Science
SC.H.3.2.1 Tools to solve problems
SC.H.3.2.2 Importance of Data
SC.H.3.2.4 Forming New Ideas

Vocabulary
Terrestrial archaeology

Initial Discussion
1. Ask students how they think underwater archaeological investigations might be different than terrestrial (above-ground) investigations. Ask them to consider what kind of training and equipment the archaeologist would need.

2. Have the students read the articles before the class discussion. Students should underline any words in the articles that they do not understand.

3. Note: You may have students read the article *before* the class, *during* class, or as homework *after* the class.

Hands-On Activity
4. Arrange students into small discussion groups (2-4 students per group). Hand out blank paper.

5. First ask students to identify any unknown or uncertain terms. Prompt them to determine the meaning of the word from the context in the article. Define terms or have students look up definitions.

6. Use the information from the two underwater archaeology articles to develop a T-chart comparing and contrasting underwater and terrestrial archaeology.

7. Challenge the students to divide their list into 3 to 5 distinct categories of differences. (Examples of categories might include archaeological techniques, equipment, risks, and types of sites.) Discuss the class findings.

Relate Activity to Concept
8. Ask students to consider what types of training or skills would be necessary for an underwater archaeologist. Discuss careers similar to underwater archaeology (marine biology, scuba instructor, marine geologist, etc.)

9. Underwater archaeologists must have extensive training in archaeological techniques as well as scuba diving and underwater safety.

10. As we continue to explore findings from archaeological sites such as Little Salt Spring, keep in mind the difficulty in researching underwater sites.

Lesson 1-3: Underwater Archaeologists

Assessment
Have students write an essay comparing and contrasting underwater and terrestrial archaeology.

Modifications/ Extensions

Use Archaeology Cards to initiate class discussion. Give each group of students a set of cards to read and divide into categories. Divide the cards equally among the group members. Read the cards aloud and group together cards with similar concepts. Determine at least 3 to 5 distinct categories for the cards.

Read the articles aloud or record for playback. Read the cards or articles aloud for student to listen and take notes.

Underwater Archaeology Cards

Watching Casey Coy and Rick Gomez prepare to dive into Little Salt Spring is like observing a pilot get ready for take off. Step by step, the two divers painstakingly review their equipment, instruments and procedures before taking the plunge into the prehistoric underwater site. When you're 242 feet underwater, there's no time for mistakes or miscommunication. "Is it dangerous? It could be, if we didn't go through the checks."	Strong currents can make it difficult to stay in one place while trying to carefully document the position of artifacts in a site. Underwater archaeologists must be strong swimmers, as well as experts in archaeological techniques.
Water temperature limits the time divers can spend underwater. Many Florida springs are a constant 73 degrees Fahrenheit. That may sound warm, but after an hour of being submerged in 73-degree water, you could feel very cold. Wetsuits are insulated diving suits that fill with water, which then warms to body temperature.	Light is limited in many underwater sites. "It is like diving into an abyss, or venturing into a black hole in space. What little sunlight there is quickly dissipates the deeper you go. It's like standing on the edge of the Grand Canyon, except that you can't see anything but darkness below."
Very few people can access deep underwater sites. Therefore, many underwater sites have been basically undisturbed for hundreds or thousands of years. The artifacts have not been taken for personal collections or sold on the Internet. While unique artifacts are difficult to retrieve, they can give much more information about history because they have been left close to their original place.	Some types of artifacts will absorb water more easily than others. For example, wooden spears soak up water, but stone does not. So when wooden artifacts are removed from underwater sites, the archaeologists must be careful that the water-soaked wood does not disintegrate when it's brought to the surface. They must use special techniques to preserve wooden artifacts.

Underwater Archaeology Cards

When exploring a deep-water site, underwater archaeologists must breathe a special mix of gases in their air tank. Nitrogen gas makes up most of the air in our atmosphere. We breathe in both nitrogen and oxygen, but our bodies only need the oxygen. At depths over 90 feet, nitrogen can become dangerous to a diver. Nitrogen can make a diver lightheaded, dizzy, forgetful, and confused! Deep divers use a mix of air and helium, which reduces the effect of nitrogen on the brain.	A kick of a flipper can send clouds of mud into the water, making it difficult to see. Underwater archaeologists must be careful not to disturb too much sediment when they are excavating artifacts. Otherwise, they may have to wait until the water clears to continue.
Dr. John Gifford, an underwater archaeologists from the University of Miami knows how expensive research can be. "The rule of thumb that has emerged from several decades' worth of underwater work is that, all other things being equal, it costs about ten times as much to excavate an underwater project as a comparable land project.	Since scuba divers cannot speak underwater, they use a combination of hand signals and writing messages on a waterproof board. They must be well-prepared in advance, so that everyone on their team knows what to do once they reach the site.

Underwater Archaeology Articles

Archaeologists plumb depths of ancient spring

By LIZ BABIARZ, Sarasota-Herald Tribune, Jan. 18, 2006.

NORTH PORT – Watching Casey Coy and Rick Gomez prepare to dive into Little Salt Spring is like observing a pilot get ready for take off.

Step by step, the two divers painstakingly review their equipment, instruments and procedures before taking the plunge into the prehistoric underwater site.

They say such meticulousness is imperative: When you're 242 feet underwater, there's no time for mistakes or miscommunication.

"Is it dangerous? It could be, if we didn't go through the checks," said Gomez, diving safety officer for the University of Miami.

Coy, who works for the Florida Aquarium, and Gomez are the first divers to explore the bottom of Little Salt Spring, a sinkhole in North Port that contains wooden stakes, stone tools and other artifacts used by Florida's earliest inhabitants, the Paleoindians.

While researchers from the University of Miami, led by John Gifford, have conducted several explorations of shallow parts of the spring over the past 20 years, no one has ever mapped out the bottom.

It's taken Coy and Gomez many years to learn how to use the equipment and the technology needed to conquer this deep and dark dive.

Wearing four cylinders of blended-gases that allow them to stay underwater longer and carrying high-intensity flash lights to guide their way, Coy and Gomez completed nine trips to the floor of the hourglass-shaped spring last week.

They hope the data they collect there will help answer basic questions about the spring: Where is the water coming from? What caused the spring to develop thousands of years ago? And why does the water act like formaldehyde, preserving organic artifacts from decomposition?

The sliver of the sinkhole that has been studied so far has yielded ancient stones and tools as well as the bones of prehistoric animals such as mastodons and mammoths. But most importantly, archeologists have recovered organic matter – plant remains, hair, brain tissue and rope – that would have deteriorated on land.

Some of the artifacts date as much as 12,000 years, when archeologists believe the spring was an oasis that attracted seasonal hunters and gathers. Over time, the water table of the spring rose, protecting the remains of prehistoric man in the underwater sediment.

Underwater Archaeology Articles

Matter of Time

BY ROBERT C. JONES, JR., Miami Magazine Spring 2001.

It is like diving into an abyss, or venturing into a black hole in space. What little sunlight there is quickly dissipates the deeper you go. Marine archaeologist John Gifford has plunged into these murky depths on numerous occasions. And each time it doesn't get any easier. "You're swimming down this giant funnel," says Gifford, describing the 220-foot-deep Little Salt Spring, an hourglass-shaped sinkhole on Florida's Gulf Coast. "And as you get to the neck of the funnel, 40 feet down, you literally come upon a circle of rock that represents the actual opening into the cavity. It's like standing on the edge of the Grand Canyon, except that you can't see anything but darkness below."

You might wonder why Gifford, an associate professor at the University of Miami Rosenstiel School of Marine and Atmospheric Science, makes the dive at all. But it is crucial that he dives deeper, for the sake not only of his own research but also for the very history of civilization. For somewhere, still waiting at a depth yet explored, perhaps lies evidence of people's earliest presence in the Western Hemisphere.

"Already we have found some remains that are 7,000 to 8,000 years old," explains Gifford. "But what's remarkable is that we have even found brain tissue with some of the remains. It's truly one of the most intriguing archaeological sites in North America." A land development company donated the sinkhole to the University in 1982. Ever since then, Gifford has been exploring the site either alone or with small groups of graduate students, who scuba dive into the sinkhole and carefully remove artifacts from different levels.

The sinkhole is an archaeologist's dream come true. Located in southern Sarasota County about five miles from the Gulf of Mexico, it has yielded a treasure trove of well-preserved ancient relics, including the bones and teeth of mastodons and giant sloths, and wooden artifacts dating back 8,000 to more than 12,000 years ago. The oldest item found so far: a sharpened wooden spear carbon-dated some 12,200 years old. It was used to kill an extinct species of giant land tortoise, whose shell was found surrounding the spear on a ledge 85 feet below the surface.

But the most important discoveries are yet to be made. Gifford and his students could be on the brink of finding human remains older than Kennewick Man, whose 9,200-year-old skeleton was discovered four years ago in the state of Washington. Human remains and artifacts already recovered from the sinkhole as well as evidence of early human habitation in the surrounding area of the site are strong indicators that they will.

A human skull with preserved brain tissue was found at the site by scuba divers in the late 1950s. Evidence of a very early settlement near the sinkhole dating back 6,000 to 7,000 years also was found, when archaeologists working at the site in the 1970s discovered some 100 to 1,000 burials nearby. Test excavation of two burials showed remarkable preservation of bodies, including fatty tissue, hair, and fingernails still intact.

Underwater Archaeology Articles

Matter of Time, p. 2

"Little Salt Spring could open a very clear window into the earliest period of the Paleo-Indian settlement of Florida," says Gifford.

That anything—especially human remains—could survive for so long is a remarkable story in itself. But it is the delicate chemical makeup of the water in this 75-yard-wide sinkhole that has made it so. Water in the sinkhole is brackish and nearly devoid of oxygen, and it is this anoxic water that has served as a natural preservative for thousands of years.

"This is water that has its own chemistry; there's almost no microbial activity, and no bacterial decomposition," says Gifford. "It has preserved incredibly well some of the material that on land simply doesn't last more than a couple of hundred years. Little Salt Spring is not only an archaeological site but one of the most intriguing geological sites I've ever investigated."

If anyone should know, it is Gifford. He's been studying prehistoric underwater sites for a good portion of his life. His primary interest, he says, lies in the relatively little-studied area of searching for remains of human settlements that have been submerged since the end of the last ice age.

"Prehistoric sites on the continental shelf mostly," says Gifford. "It turns out that Little Salt Spring is an example of one of these sites—one that was exposed to the air 10,000 or 12,000 years ago because the water table here in Florida was more than 200 feet lower than it is right now."

Underwater archaeology is a painstaking process compared to the excavation of a site on dry land. It oftentimes requires an even greater deal of time and patience—and money.

Says Gifford: "The rule of thumb that has emerged from several decades' worth of underwater work is that, all other things being equal, it costs about ten times as much to excavate an underwater project as a comparable land project.

"Then you have the obvious problems of working in an alien environment and being completely dependent upon your scuba equipment," he says. "If there's a mechanical failure, then you have a major problem to deal with."

Diver-to-diver communication is accomplished by writing messages on a plastic board. "A very tedious process," he says. "But the one factor that really limits the time we can spend underwater is water temperature. It's a constant 73 degrees Fahrenheit. That may sound warm, but after an hour or two of being submerged in 73-degree water, unless you have a really warm wet suit or dry suit, you get very, very cold."

Underwater Archaeology Articles

Matter of Time, p. 3

Despite such difficulties, Gifford and his students press on, for they know that one of the most significant discoveries in the history of archaeology is within their reach. Given the artifacts and human remains already discovered at the spring, it seems likely that it is only a matter of time until they locate the oldest-known skeletal remains. Unfortunately, it also is a race against the clock.

The sinkhole, located in North Port, Florida, halfway between Fort Myers and Sarasota, is part of one of the state's most rapidly developing regions. Residential communities, schools, and golf courses now surround the site. Gifford is afraid that water runoff and other pollutants from encroaching development could imperil the sinkhole's chemistry and accelerate the decay of artifacts and human remains.

"We need to monitor the water quality of the sinkhole over the coming years to make sure that we don't see any changes in the water chemistry," says Gifford. "Or we could lose what's literally a natural time capsule to the very earliest human occupation of this peninsula."

Module 2: Studying Florida's Prehistory at Little Salt Spring

Introduction

Florida's landscape and ecosystems have changed dramatically over time as a result of Ice Ages. When much of North America was covered in glaciers (ice sheets), water was trapped in the ice and the sea level dropped. As a result, upland Florida was much drier, and the water levels in springs and rivers dropped.

Paleo-Indian is a term used to describe Native Americans who lived in Florida between 12,000 and 8,500 years ago during the last Ice Age. During this Ice Age, glaciers covered much of North America, and sea levels were much lower than today (about 160 feet lower 10,000 years ago). Florida was about twice its current size. The climate was cooler and drier than today, and rivers, lakes, and springs were relatively scarce on land. Paleoindians hunted large mammals that became extinct soon after the Ice Age ended – mammoth, giant ground sloth, tapirs, and saber-tooth cats.

The Archaic time period, between 5,000 and 7,500 years ago, showed a change in culture, tool technology, and settlement patterns. The climate was significantly warmer and wetter, sea levels rose, and water sources became more available.

Because these two cultures lived so long ago, few artifacts remain besides stone tools. Artifacts made from plant or animal materials (wood, bone, antler, etc.) will decompose over time; the rate of decomposition depends on the environmental conditions. Artifacts in warm, humid environments will decompose faster than artifacts in cold, dry environments. Artifacts submerged underwater without much exposure to oxygen will decompose at a much slower rate that artifacts exposed to air. So some of the best sites for Paleoindian and Archaic artifacts are underwater sites, such as springs, rivers, and wetlands.

Little Salt Spring is an underwater archaeological site near Sarasota, Florida, that is currently being investigated through a unique partnership between the University of Miami and the Florida Aquarium. Paleoindians lived around the spring and used it as a water source when the water levels were much lower. When the glaciers melted and sea level rose, Paleo-Indian artifacts were submerged. Archaic people buried their dead in the wetlands surrounding the spring. Because the site has been relatively inaccessible geographically and logistically (requires extensive scuba gear to access deep sites), many artifacts still remain to be found in this exciting unique project.

Two articles are included as background information for this module. One discusses the Little Salt Spring underwater archaeological site and prehistoric Floridians, and the other discusses how the environmental conditions and cultures changed from the Paleoindian to Archaic time periods.

Resources:

Wisner, George. "Diving into Paleo Florida" Mammoth Trumpet Vol. 23, No.1 Center for the Study of the First Americans, Texas A&M University.

Weitzel, Kelly G. "Environmental Adaptation: The Shift from Paleo to Archaic Survival Strategies" Pelotes Island Nature Preserve. http://pelotes.jea.com/NativeAmerican1/Paleo.htm

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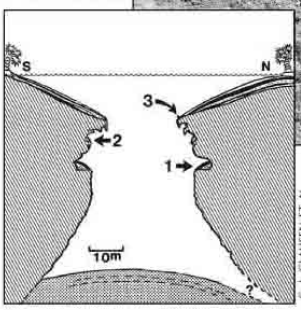
DIVING into Paleo Florida

BEFORE THE NORTHERN GLACIERS MELTED, sea levels rose, and water became more plentiful, long before there was an Everglades and Lake Okeechobee, Florida's lower peninsula was a cool, dry savanna-like landscape about twice as broad as it is today. Freshwater was scarce. Near the center of this prehistoric landscape, a site in southwest Florida today less than 10 miles inland from the Gulf of Mexico, sparkled a particularly attractive watering hole that drew hunters and prey.

Near the twilight of the last Ice Age, a hungry prehistoric hunter watched a giant land tortoise crawl along the edge of this oasis. For the hunter, this ancient evening turned out well. He impaled the tortoise on a sharp stick and cooked it on site for a hearty meal. That's the picture described by underwater archaeologists who more than 12,000 years later found the shell of the now extinct tortoise species pierced by a stake on what is known as the "27-meter ledge," a shelf 90 ft below the present surface of Little Salt Spring. The tortoise, we have to remember, was killed on dry land that existed before the site was later inundated and incorporated into the depths of the widening spring.

In John A. Gifford's view, Little Salt Spring (8SO18) near North Port in Sarasota County, Florida, is one of the most significant archaeological sites in North America. Dr. Gifford, professor of marine affairs and policy at the University of Miami's Rosenstiel School of Marine & Atmospheric Science, is also principal investigator of the Little Salt Spring Underwater Archaeology Project. For more than a quarter century, the spring has given archaeologists tantalizing glimpses into the world of Paleoindian hunters and gatherers.

PETER MASA



C. J. CLAUSEN ET AL.

Above, low-altitude oblique aerial view of Little Salt Spring from the south (January 2006). *Inset,* Clausen's 1979 drawing of a cross section of the spring: **1,** the 27-meter ledge on which the tortoise and stake were excavated; **2,** the 16-meter ledge; **3,** the drop-off at 12–13 m, where most of the wooden stakes have been excavated.

It's an invariable law: Discoveries draw critics

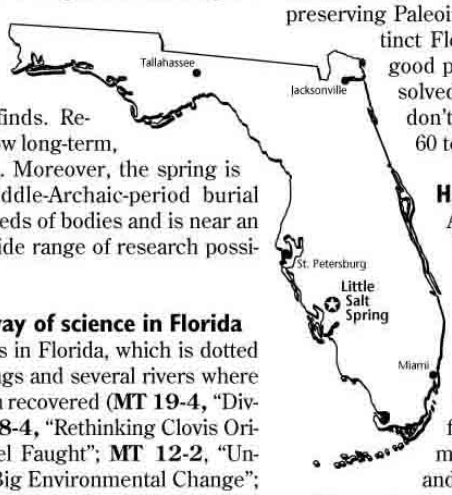
The impaled tortoise shell, one of the most important finds at the spring, dates to 12,000 RCYBP (about 14,000 CALYBP). This remarkable artifact has also been highly contentious. Some researchers doubt that the stake was actually used to kill the tortoise; the dating of the stake, they argue, is at odds with calcium carbonate dates from the tortoise shell. Gifford, using collagen dating on the shell (a technique not available to researchers in the 1970s when it was found), has determined that its age is commensurate with that earlier published for the stake in the 1979 edition of *Science* by underwater archaeologist Carl C. J. Clausen.

Some critics also claim there was insufficient "direct contextual association" between the stake and the fate of the tortoise. Clausen maintains that the stake's point of entry into the tortoise shell—along with carbonized long bones and fire-hardened clay found around the tortoise remains—strongly supports his hunter-and-prey hypothesis. Ambiguous, say the critics, who want more evidence. Although Gifford concedes that Clausen's report lacks clarity on the issue, he has evidence to calm the debate. "I found a 16mm color film shot when the tortoise was excavated," Gifford explains, "that shows the direct contextual association of the stake with the tortoise shell." Convinced it was a real association, Gifford robustly defends Clausen's published account. He plans to discuss the issue at the March 2008 SAA meetings and will likely show the film too.

Artifacts pulled from the spring over the years include a 7,000-year-old greenstone pendant, and a carved atlatl handle (spear thrower) believed to be from the Early Archaic (8,000 to 9,000 years old). The spring also yielded four non-returning boomerangs that Gifford says are so rare they may be "the only four in the world." He frankly admits that researchers don't know what to make of them; lacking comparative artifacts, they

can't identify with certainty the function of the curved throwing sticks.

Sharpened wooden stakes, wooden digging sticks, human bones, bones from such prehistoric megafauna as the giant ground sloth, and a curiously sparse collection of arrowheads and non-diagnostic lithics cram laboratory storage bins. "Mind-boggling," Gifford says of the finds. Recorded dates from the artifacts show long-term, continuous occupation of the site. Moreover, the spring is associated with an early- to middle-Archaic-period burial ground containing possibly hundreds of bodies and is near an Archaic village site—opening a wide range of research possibilities.



Submarine archaeology, the way of science in Florida

Underwater archaeology flourishes in Florida, which is dotted by more than 600 freshwater springs and several rivers where Paleoindian artifacts also have been recovered (**MT 19-4,** "Diving into Florida Prehistory"; **MT 18-4,** "Rethinking Clovis Origins: A Conversation with Michael Faught"; **MT 12-2**, "Underwater Site Opens Window on Big Environmental Change"; **MT 10-1**, "Underwater Site Details Mastodons' Life History"; **MT 3-2**, "Florida Archaeologists Plunge Into the Past").

Little Salt Spring was originally believed to be a shallow-water pond. In 1959 William Royal, a retired Air Force officer, began scuba diving there and discovered it to be an hourglass-shaped sinkhole nearly 80 m deep, typical of Florida's karst topography. Early researchers describe its surface as approximately 78 m in diameter and about 5 m above sea level. A sinkhole is similar in many respects to the *cenote* found in the Yucatán—a relatively shallow water-filled basin above a vertical underwater cavern (**MT 20-3,** "Early Humans South of the Border: New Finds from the Yucatán Peninsula"). In a sinkhole, deep vents at the cavern bottom feed oxygen-depleted ground water, producing an anoxic environment below a depth of about 3 m. Bacteria necessary for decomposition are prevented from forming, thus creating an ideal environment for preserving Paleoindian artifacts as well as fossil bones of extinct Florida megafauna. "We have extraordinarily good preservation because there is almost no dissolved oxygen in the water," Gifford says. "We don't have 100 percent preservation, but we have 60 to 70 percent preservation, and that's great."

Hard-won fame for a challenging site

As a graduate student in the 1970s, Gifford heard of archaeological discoveries being made at the spring. It was about the time when the property owners, the General Development Foundation, hired Clausen, then the Florida State Archaeologist, to direct the Little Salt Spring Research Facility. Thus began an intensive era of company-financed academic research there. Clausen made many of the earliest finds at the spring and set the stage for Gifford's later study.

Clausen's years of research at the spring convinced him of the overall importance of the site to understanding Paleoindian life. "Unique cultural evidence," he writes, "especially artifacts of wood, bone and shell, which seldom survive in the Southeast, has been preserved in what can be described as a natural time capsule at Little Salt Spring." The site has yielded evidence among the earliest of human activity in Florida, their association with an extinct vertebrate in the Southeast, and evidence that they preyed on an extinct species of giant tortoise. (The evidence of early human presence at Little Salt Spring is supported by the discovery below the Aucilla River surface of an American mastodon tusk bearing cutmarks. The tusk has been dated to 12,425 ± 35 RCYBP.) Clausen determined that humans occupied the site between 12,000 and 9,000 years ago, and again between 6,800 and 5,200 years ago. Gifford emphasizes that his research confirms Clausen's conclusions concerning the site's occupational dates and archaeological significance.

J. GIFFORD

Digital photomosaic, made from five 35mm color slides taken underwater in December 1975, shows the stake in direct association with the tortoise (the plates are the shattered plastron) in the excavation trench on the 27-meter ledge.

State and federal officials in 1979 placed Little Salt Spring on the National Register of Historic Places, thereby confirming the site's research potential. In 1982, the General Development Foundation donated the site to Miami University. The university in 1983 hired Gifford to direct the present Little Salt Spring Project. Unfortunately they didn't hand him a pot of money, the

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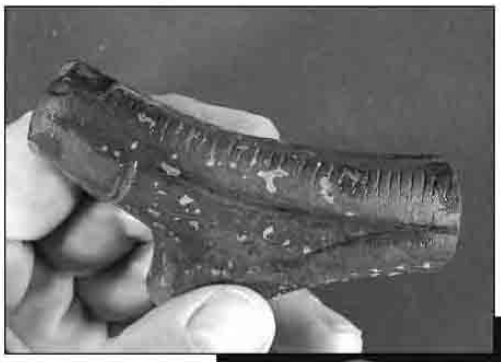
THOMAS STREET

Gifford (*right*) describes late-Paleoindian wooden artifacts recovered from Little Salt Spring basin excavations to a local newspaper reporter.

mother's milk of archaeology. He admits that finding money to continue research has been difficult. Conducting underwater archaeology is expensive—about 10 times more costly than terrestrial archaeology. A lack of funds curtailed research at the site between 1982 and 1992, but money has gradually surfaced. The University of Miami and other donors fund activities, including underwater archaeological field schools up to three weeks in duration that Gifford has conducted since 1993.

The hard way to do business

Gifford's underwater work is time-consuming and equipment-intensive. Working conditions in the field are quite different from those faced by terrestrial archaeologists. A 2007 feature story in the *Tampa Tribune* recounts a typical underwater session: After wriggling into scuba gear and tanks, research divers cross a pontoon bridge onto a floating platform at the spring. From there, they plunge through upper level aquarium-like swarms of small fish and turtles to deeper excavation sites. Using an underwater vacuum powered by a pool pump, divers clear specific areas, working from a suspended trampoline secured by plastic pipe to hold equipment and collected artifacts. Excavation moves with tortoise-like slowness, with divers frequently measuring minute progress in weeks. Gradually, though, the spring yields a few more of its secrets.



BOTH: J. GIFFORD

Late-Paleoindian (ca. 9250 RCYBP) deer ▲ antler artifact of unknown function recovered from Little Salt Spring.

Middle-Archaic greenstone pendant from ▶ the east slope of the Little Salt Spring basin, ca. 6000–7000 RCYBP.

"Much of the work we have done has complemented Clausen's work," Gifford says. After more than a decade, Gifford's research has yielded more wooden tools and a pendant of non-native greenstone that possibly came as a trade item from the Appalachian region, the suspected source of the greenstone. His team has also found a second greenstone pendant, which has yet to be identified and sourced, and a series of pointed wooden stakes excavated from about 35 ft below the water, one of which has been dated at 9350 ± 90 RCYBP (Beta-216035), about 10,500 CALYBP. Gifford is confident the stakes were driven into sediments at the drop-off above the water's surface during the late paleo period. He suspects that the stakes served as anchor points for lowering objects, perhaps people, over the edge and down into the throat of the spring to the water's surface, which at that time may have been 20 ft below the level of the stakes, or about 55 ft below the present surface of the spring.

Not only have money problems eased since Gifford took over research at Little Salt Spring, help of a non-financial nature appeared in the person of 26 divers with the Florida Aquarium, boasting more than 1,000 hours' combined diving experience, who have participated for the past three years. The Aquarium also plans to exhibit some of the artifacts recovered by Gifford's team. The restored tortoise shell and stake have been on public display at the Museum of Florida History in Tallahassee.

Meanwhile, Gifford's field school students have opened three 2-by-2-m underwater test excavations. "Actually," he explains, "we are still working on one of them because we have not yet hit bedrock." The process gobbles time, and sometimes divers surface empty-handed. Progress can be maddeningly slow: In a 2-week field season in 2007, it took one week just to excavate a 10-cm-deep level. However, with the excavation now coming onto new sediments, the potential is promising. Divers haven't yet hit bedrock, further buoying Gifford's hopes for new finds.

Gearing up for the job

Other benefits, too, accrue from work at the site. Researchers are perfecting new techniques for recording excavations. To take the place of still photography and sketching artistry used by their terrestrial counterparts, Gifford and his fellow re-

searchers create digital video mosaics of the excavation. The process saves time in their underwater time-pressured environment and produces more detailed results than traditional methods. Gifford has amassed a large database of digitized records that can be quickly and easily expanded, used, and shared with other researchers.

Excited about finds at the site to date, Gifford is eager to take the next major step. His sights are set on the 27-meter ledge. Only 5 percent of this natural re-entrant has been explored, and Gifford believes it has the greatest potential for extremely old finds. Exploring it, however, will be a particularly expensive venture, requiring specialized equipment and an exotic mixture of breathing gases for divers that includes helium, nitrogen, and oxygen. The optimum breathing mixture allows divers to stay at the 90-ft depth for 50 to 60 minutes in the morning and the afternoon, a marked increase over 20 minutes of bottom time limited by the standard compressed-air breathing mixture—which also requires a lengthy decompression time and involves added health risks. More bottom time means more opportunity to make discoveries.

J. GIFFORD

Underwater photo, taken in March 2006, of a partially excavated oak stake in situ at a depth of about 12 m. Since the upper portion of this stake, like all the others, is missing, its original length is unknown. This stake has been dated to 9350 ± 90 RCYBP, or 10750–10260 CALYBP (2-sigma). Gifford admits that "we still don't know why these stakes were being driven into the soft sediment just above the drop-off." Clausen's theory is that they were "belaying pins" to secure ropes used to lower something to the water's surface, which 10,000 years ago would have been a few meters below the drop-off.

Data with an unsettling edge

Little Salt Spring has opened a window on Paleoindian life. The site also has given researchers a yardstick for measuring climate change, and the data reveal a fact that may bode a bleak future for human habitation of south Florida.

At the nub is how to explain the fact that no cultural remains younger than 5,500 years have been found in the sinkhole. This issue has puzzled researchers for years because it suggests human occupants suddenly abandoned the site. The prevailing wisdom, whose adherents included Clausen, theorizes that the exodus was the result of climate change, perhaps because the area around the spring became more arid and therefore less habitable, or perhaps because burgeoning water supplies elsewhere, caused by climate warming and glacier melt, lured people away from Little Salt Spring.

Gifford's team, however, offers an alternate hypothesis that suggests the site bears witness to an ancient event hostile to humans. In a study presented in the 2005 edition of the journal *Palaeogeography, Palaeoclimatology, Palaeoecology*, Carlos A. Alvarez Zarikian (a graduate student of Gifford's), Gifford, and others examine fossilized organisms known as ostrocods found in Little Salt Spring. They conclude that increases in saltwater, as glaciers melted and sea levels rose, may have degraded the water quality at the spring and forced humans to seek habitation elsewhere. Their study is a cautionary tale of what may lie in store for Florida if global warming causes a rise in sea level as predicted. "I have seen a number of predictions," Gifford remarks, "and it doesn't look good for south Florida." His primary concern, however, is uncovering the lives of past occupants around the spring.

Although Gifford concedes that we may never know for certain what caused people to vacate the spring, he is confident that continuing paleoenvironmental research will more clearly define the chain of events taking place at what had once been, without question, a scarce oasis and valued hunting ground for a very long time. It most certainly should produce more artifacts to examine.

"I think we have the potential for finding very old, and very well preserved, material," Gifford says. "We certainly have an untapped reservoir of material to explore here."

–George Wisner

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Suggested Readings

Clausen, C. J., A. D. Cohen, C. Emiliani, J. A. Holman, and J. J. Stipp 1979 "Little Salt Spring, Florida: A Unique Underwater Site." In *Science*, 203:609–14.

Kornake, S. 2007 "Deep in Florida's Past: The Artifacts in Little Salt Spring Could Help Rewrite History." *Tampa Tribune*, Metro Section, Monday, July 2.

Zarikian, C. A. A., P. K. Swart, J. A. Gifford, and P. L. Blackwelder 2005 "Holocene Paleohydrology of Little Salt Spring, Florida, Based on Ostracod Assemblages and Stable Isotopes." In *Palaeogeography, Palaeoclimatology, Palaeoecology*, 225:134–156.

Environmental Adaptation
The Shift from Paleo to Archaic Survival Strategies

Written by Kelley G. Weitzel
Provided by the Pelotes Island Nature Preserve - pelotes.jea.com/NativeAmerican1/Paleo.htm

Paleo-Indians and their Archaic descendants shared a variety of cultural traits which helped them to survive in Florida's prehistoric environment. The areas in which they differ reflect unique adaptations to their gradually changing local environments. (Culture can be defined as a people's efforts to cope with their environment.) The Florida which greeted Paleo-Indians, perhaps 12,000 years ago, was far removed from the conditions in our modern wetland state. Its cooler, dryer climate forced these natives to develop cultural patterns vastly different from Florida's historic peoples. Four prime aspects of this adaptive culture include settlement patterns, technology, subsistence, and lifestyle. By reviewing the similarities and differences between Paleo-Indians and Archaics in light of these environmental shifts, archaeologists have concluded that the Archaics are descendants of these earlier groups, not an influx of new cultures. This gives Florida a human history stretching unbroken for almost 12,000 years.

When viewed through an ecological lens, the shift from Paleo-Indian technologies to Archaic ones is merely a transition. It is not an abrupt change of lifeways, which might indicate an invasion of outside ideas and technologies. Rather, it is a slow technological and ideological shift to accommodate the fluctuating environment and food base. The Florida of Paleo-Indian times was considerably cooler and drier than its modern counterpart, creating a grassy savanna rather than today's thick pine forests. This affected the natives' settlement patterns as well as the land itself. Glaciers were the most influential environmental factors, holding much of the continent's fresh water frozen, and lowering the sea level over 160 feet below modern levels. 10,000 years ago, Florida was much larger, perhaps twice the size it is today. A large part of this exposed continental shelf contained limestone deposits in western Florida. During a time when fresh water was scarce, these limestone pits allowed the collection of rainwater into pools, and provided the geography for deep sinkholes. Paleo-Indians (and their prey) were forced to gather around these rare sources of fresh water. The deciding factor for setting up a Paleo home site was probably access to fresh water. These home sites supported less than 25 individuals, probably a kin group, in which the sharing of limited resources would do the most to protect a single genetic line. They were semi-nomadic, following both their food base and seasonal water availability. Moving from watering hole to watering hole allowed them to utilize an area fully, and then allow it to recuperate as they moved on. This oasis theory, by James S. Dunbar and S. David Webb, has been corroborated by evidence of Paleo-Indian camps all over the limestone regions of Florida.

Archaic Indians, however, enjoyed a much milder environment and a wider distribution of home sites. A gradual wet trend began around 8000 BC which opened up new territory for the natives. Discrete deep springs joined up to form rivers and marshy systems. As the water table rose, Florida came to look more and more like the state we recognize today. By 3000 BC, the environment had stabilized into modern form. This shift from dry prairie to wet forest and marsh occurred gradually over five thousand years, but it is still a drastic change, which affected Florida's coastline and interior. Half of the state was inundated as the glaciers melted.

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This removed many suitable Paleo-Indian occupation sites. However, the same rise in water level opened up many more fresh water areas for occupation. With greater access to fresh water, other environmental aspects became factors in selecting home sites. Shellfish became an important resource, drawing some natives away from inland Florida to dwell in coastal marshes. The change in climate shifted the food base in other ways, away from migratory megafauna towards smaller resident species. These steadier sources of food and water allowed Archaic peoples to live in larger groups, upwards of 40 individuals. Rather than maintaining a semi-nomadic lifestyle, these people had a strong enough resource base to stay in one (or a few) rich areas. They had a central site with several outlying special purpose camps. Rather than fully exhausting an area's resources, and moving on, they probably utilized multiple resource areas around a home base. If they located their base in a forest along a river, they would have access to fresh water and shellfish as well as forest flora and fauna. A short trip to the northeast might place them in a salt marsh full of fish and oysters. Just to the east lay the ocean with its wealth of shellfish, sharks, sea turtles, marine mammals, and fish. A trip southwest might give them access to chert for tools. This expanse of the food base is characteristic of Archaic peoples, and allowed them to live in larger groups and stay in the same place for longer periods of time.

Settlement patterns for prehistoric Indians are fairly easy to track, by simply locating sites with artifacts. (This becomes increasingly difficult, of course, as you go earlier in time and further under water.) The best-preserved artifacts tend to be lithic tools and other forms of technology. As a result, early methods of categorizing Florida's prehistoric natives relied on their stone tools. This may have prejudiced our view of the natives, especially Paleo-Indians, because the archaeological record is not egalitarian in what it preserves. Textiles and wooden artifacts are often lost. However, due to several wetland burial sites, archaeologists today have some good examples of these aspects of Paleo-Indian technology. The lithic tools are generally large bifacial lanceolate points designed for hunting the megafauna of the late Pleistocene. These tools were generally made of non-native, high quality stone, to be hafted onto a foreshaft, and then a spear. Other unifacial artifacts seem to be designed as multi-purpose tools. It has been suggested that this provides a smaller tool kit, which is easier to carry around than multiple specialized tools. This small tool kit is characteristic of the Paleo-Indian whose semi-nomadic lifestyle encouraged him to travel light. Other tools included bone pins, used to hold back the skin during defleshing, scrapers, etc.

In addition to stone, other raw materials for tools included bone, mastadon tusk, antler, and wood. The latter are less well-preserved in the record, and call to question what other tools might have been lost over time. Shell tools are conspicuously absent in the Paleo record, indicative of their inland settlements away from easy access to ocean resources. Pottery is also absent; not yet invented. In any case, pottery is very heavy, not conducive to a semi-nomadic existence. Containers probably included baskets and sacks woven from plant materials as well as bags made from hide, stomach, bladder, or twisted hair. Wooden digging sticks, although usually invisible to the archaeological record, would have been invaluable in the collection of tubers and other plant materials. In general, the Paleo-Indian tool kit was small and lightweight, often composed of multi-purpose tools, well-crafted Suwannee points, and other utilitarian artifacts.

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Archaic peoples had a more diverse tool kit, both in response to a more diverse food base and a more sedentary lifestyle. Their projectile points are, in general, smaller and made of poor quality local chert. The variety of point types suggests that different points were utilized for different prey or for knives instead of projectiles. A wide range of artifacts including scrapers, choppers, and composite tools characterize the Archaic lithic assemblage. Evidence of local quarry sites and heat-treating of the chert (to make it less brittle and easier to work) are first found during the Archaic as well. One-use tools, as opposed to finely crafted bifacial points, are common in the Archaic. With access to local quarries, it may have been simpler to use and discard simple flakes than to shape, reshape, and preserve old high-quality stone tools. Early Archaic tools resemble those of the Paleo-Indians, with points like Bolen beveled and plain forming possible intermediates. As the Archaic proceeds, the tool kit expands, pointing to a slow advance in technology. Although Archaic points were smaller than Paleo points, suggesting smaller prey, the points were not tipping arrows. The Archaics are probably using smaller spears and atlatl (spear thrower) darts. Bannerstones (atlatl weights) and bola stones are also found. Although these were found in the Paleo record, their use seems to boom in the Archaic. Other ground-stone artifacts, like bowls, are found in this time as well. An increase of items like choppers in the Archaic assemblage suggests a stronger reliance on plant material than previous natives had.

Fewer tools are found made of tusk, pointing to the disappearance of the megafauna. Instead, antler and bone become important in making antler hammers, bone pins, awls, points, fishing spears, and antler handles. Wood, and perhaps rivercane in the wetter environment, is used to haft weapons, grind vegetable matter as a mortar and pestle, build fairly permanent huts, and make canoes. Some heavy wood-working tools have been located at Archaic sites which suggest they were making items too large to haul around easily. The canoe itself represents a serious increase in mobility for the Archaic peoples, making it easier to trade and form alliances with distant peoples. Shell technology also booms during the Archaic, as people are living closer to coastal areas. *Busycon* hammers, axes, bowls, and columellae become fairly common in the record. The use of shell technology is a hallmark of the Archaic Indians.

In the late Archaic, the introduction of pottery is another serious technological advance. The clay for this Orange Period pottery was tempered with fibers of Spanish Moss or palmetto trunk, then fired to make it waterproof. Towards the end of the Late Archaic, sand was often added to the mix, which heralds a general shift to sand-tempered pottery occurring after the Archaic. These shifts once again indicate that Florida's cultures represent a single descendent group, rather than invasions of ideas or peoples over the years. The advent of pottery meant several things to the Late Archaic peoples: a good way to store food for the winter, an easy way to cook stews and broths, and probably a more sedentary way of life that didn't involve hauling this thick slab pottery around everywhere. Digging sticks and other plant collecting tools were probably in great use. Traps and fishing weirs may have become important as well. Now that the Archaic peoples were settling in an area, they had to intensify their food collection patterns to support more people in a smaller space. Traps and weirs allowed them to hunt without actually spending time doing it.

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Technological breakthroughs like these helped the Archaic Indians develop into the more complex cultural groups of post 500 BC. In general, the Archaic tool assemblage has more specialized tools, utilizes local chert, bone, antler, shell, and clay, includes traps, vegetable processing equipment, pottery, canoes, and more permanent housing.

This prehistoric technology is tracked through artifacts. Prehistoric diet is only slightly more difficult to discover, through faunal assemblages in middens, tools, and in studies of burial remains. Paleo-Indians are often considered large game hunters, and this is perhaps a bias in the archaeological record associated with the large number of kill sites found. Even in Florida, there is evidence of a species of large elephant with spinal butchering marks and a bison skull with a prehistoric point embedded in it. These megafauna, including mastadons, horses, bison, camels, sloth, tortoise, and tapir were largely migratory, forcing the Paleo-Indians to follow herds or else live through stages of plenty and starvation. Anthropological evidence based on modern hunter-gatherers suggests that the Paleo-Indians also relied a great deal on plant matter, perhaps as much as 65%, to cushion the times between the herds. In the dry Paleo environment, grain bearing grasses would have been an important source of carbohydrates. The Paleo peoples probably also utilized smaller animals to some degree, including deer, raccoon, opossum, fish, snails, etc. Communal hunts and gathering expeditions collected enough food for the group's survival, but not enough to keep it extremely healthy. Many exhumed skeletons show signs of dietary stress.

This is also true for Archaic Indians, but as a rule, there was more food and more variety for these later peoples. A wetter, more forested Florida contributed to the end of the megafauna, but it also opened up a wealth of food material focused on plant life and on the marshes. As the Archaic peoples moved into coastal, marsh, and riverine environments, they began to heavily utilize shellfish. Although most shellfish middens seem to come from the Late Archaic on, pre-ceramic shell middens are now being discovered far beneath the surface. This suggests that utilization of shellfish is a serious Middle Archaic trend as well. Marshes, coasts, and rivers provided fish, shellfish, snails, shrimp, shark, alligator, turtles and terrapins, migratory birds, eggs, and marine mammals. Because the salt marsh is such a productive ecosystem, it provided year-round food for the Archaic natives, allowing full time residence. The nearby maritime hammocks provided upland habitats for them to exploit as well. Animal species hunted include deer, raccoon, opossum, tortoise, squirrel, bobcat, turkey, bear, rabbit, etc. Plant species could be collected year round. Spring provided pokeweed, clover, thistle, blackberries, peppergrass, fern fiddleheads, and sorrel. Summer provided blueberries, clover, blackberries, wild onion, muscadine grapes, peppergrass, cattails, chokecherry, ground cherry, hog plum, persimmon, saw palmetto, elderberry, and Florida chinkapin. The fall brought acorns, hickory nuts, pecans, pigweed, and sabal palm berries. In the winter, clover and thistles are coming back, and the cycle begins again. Archaics intensively utilized their environment, with a food base vastly expanded from that of the Paleo peoples. Shellfish and water resources took the place of the extinct megafauna. Deer were the most utilized land species. Plant materials became very important as groups remained in one place for longer periods of time. The Archaic is characterized by intense utilization of resources around the base camp, with special purpose camps designed for deer hunting, oyster gathering, or acorn harvesting radiating out from the center.

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While faunal and flora leave some physical remains with which to judge prehistoric subsistence, lifestyle is much more difficult to evaluate. Paleo-Indian hunter-gatherer groups were probably organized at the band level, each of roughly 25 members related by kinship ties. Men were predominantly hunters, and women gatherers. Very likely the men possessed the greater status. Resources were shared in this egalitarian society. There was little specialization and no upper class. Excellence in each field was the determiner of leadership. There was little territoriality; however, water burials may have given these people some sense of place. Their use of water burials may indicate some belief in an afterlife as well as a symbolic spirituality for the water itself.

There is a great deal more information regarding Archaic Indians, although much of it is still speculation. The groups were larger and more permanent, perhaps greater than 40 individuals. While men still did most of the hunting, and women the gathering, women probably had more status, as Archaic peoples began to seriously utilize plant materials. In general, Florida natives practiced matrilineal descent, attesting to the status of women. Children apparently possessed status and value as well, as they were often buried with grave goods. Some individuals were buried (in water or earthen mounds) with unique or special grave goods, implying higher status. Resources were still shared among the group, but there may have been unequal access to these goods. Because all ages and genders are found in burials, the cemeteries seem to have been for the entire community or kinship group, not just the elite. These peoples were more sedentary, and based more of their economy on water resources like fish and shellfish. Now that groups had specific collection sites to maintain, territoriality began to develop, and there is evidence of the resultant homicide on Tick Island. While men were responsible for hunting and any necessary battle, women controlled the family, the home, and all collection and processing of vegetable matter, weaving, pottery making, and hide tanning. This shift from a male centered Paleo society to a more female centered Archaic one can be related to the environmental shift to a warmer, wetter climate. Larger water sources allowed groups to grow in size and remain sedentary. Water bodies also increased dependence on fish and shellfish, which women can gather as easily as men. The wetter habitat also increased the number of small animals, which can be snared or otherwise hunted near the camp. All of these things, in addition to the extinction of the megafauna, contribute to making a more female-centered pottery-making society.

In each case, the shift from cool dry Pleistocene towards the modern warm wet Florida caused the natives to adapt their cultures. These adaptive changes are a continuum rather than a rapid influx of new ideas from an outside culture. Through shifts in settlement patterns, technology, subsistence, and lifestyle, Paleo-Indians evolved into their Archaic descendants utilizing new survival strategies in the face of environmental stresses.

Resources:

Brown, Robin C. Florida's First People. Pineapple Press, Inc. Sarasota. 1994.

Milanich, Jerald T. Archaeology of Precolumbian Florida. University of Florida. Gainesville. 1994.

Peterson, Lee Allen. Peterson's Field Guide to Edible Plants. Houghton Mifflin Company. Boston. 1977.

Thunen, Robert. Class Notes, Ethnohistory of Precolumbian Florida. 1996.

Lesson 2-1: Decomposition in Different Environments

Time Allotment
Set-up & Intro: 30 minutes
Weekly Observations: 10 minutes
Data Analysis & Conclusion: 30-45 minutes

Materials
Per class:
- 30-35 pieces of fruit (berries, bananas, etc.)
- 30-35 plastic cups (~1 per student)
- Pea gravel ~ 5 cups
- Masking tape
- Clear plastic wrap (to cover cups)
- Rubber bands
- Freezer or refrigerator
- Water

Per student:
- Decomposition Experiment activity sheets

Advance Preparation
Make copies of the activity sheets (double-sided is recommended).

Create stations for students to set up the decomposition cups –or– Pass out supplies during class.

Students will work in groups of 4-5.

Lesson Objectives
- Develop and test hypotheses about the decomposition rate of organic materials in different environmental conditions.
- Generate conclusions about the effects of decomposition on the preservation of artifacts in underwater archaeological sites.

Sunshine State Standards
SC.H.1.2.1 Record keeping
SC.H.1.2.2 Observation and analysis
SC.H.1.2.3 Working collaboratively
SC.H.1.2.5 Models
SC.H.1.3.1 Knowledge changes
SC.H.1.3.4 Record keeping
SC.H.1.3.5 Variables
SC.H.3.2.4 Problem solving
SC.912.N.1.1 Scientific Investigation

Vocabulary

Decomposition	Experiment
Environment	Variable

Background Information
Artifacts made from plant or animal material will **decompose** over time. The rate of decomposition depends on the **environment**, the sum of conditions affecting an organism or object. Artifacts in warm, humid environments will decompose faster than artifacts in cold, dry environment. In general, artifacts submerged underwater will decompose slowly if they are relatively undisturbed in low oxygen conditions.

Some of the most fascinating archaeological finds in Florida have been located underwater or in wetland environments. In the 1980's, an ancient graveyard was discovered accidentally near Titusville, Florida in a peat wetland. Archaeologists found over 150 individuals buried over 7,000 years ago and artifacts that were buried with them. Human remains were remarkably well-preserved, and scientists were able to extract DNA samples to analyze the population. Rare artifacts made of wood and fabric were also found intact in the low oxygen, water-logged muck. While the excavation process was extremely difficult, the information gathered from this archaeological site made it unique.

Initial Discussion
1. Discuss with students the process of decomposition. What happens to food when it rots?

2. Ask students, "How quickly will objects decompose in warm versus cold weather? Underwater versus above ground?" Accept all answers.

3. Hand out the activity sheets. Have each student write their hypothesis for the research question, "How quickly will buried artifacts decompose in warm, cold, wet, and dry conditions?"

4. Ask students to describe some ways their hypotheses could be tested.

Lesson 2-1: Decomposition in Different Environments

Hands-On Activity

5. Tell students that they will be setting up an experiment to test the decomposition of organic materials in different environmental conditions. They will use fresh fruit because they decompose faster than wood or other types of organic material.

6. Have students review the procedures on the activity sheet. Divide the students into small groups. Each group will set-up one cup for each variable. They should label their cups and set the cups in the designated area – freezer, outside, or in the classroom.

7. Once a week, have one group open their cups, exposing the buried fruit. They will observe their cups, and then will share their results with the class. You may choose to have each group observe the set of cups as well. All students should record their observations in the appropriate spaces on the activity sheet.

8. At the end of the observation period (3-4 weeks) have students open all the remaining cups. All students should get a chance to observe all the cups to complete their activity sheet.

Relate Activity to Concept

9. Have students analyze their findings. Ask them what they can conclude about decomposition in different environmental conditions. In which conditions did the fruit decompose fastest? Slowest?

10. Ask students to consider the impact of decomposition rates on the preservation of artifacts in different environments.

    a) Where would artifacts be best preserved? *(cold, dry or very wet sites)* Worst preserved? *(Warm, humid sites)*

    b) What kinds of artifacts might be missing from most archaeological sites? *(wood, fibers, plant remains, etc.)*

    c) What would happen to underwater artifacts if they were moved out of the water? *(decomposition would speed up and the artifacts would be lost if not properly preserved.)*

11. Have students complete the questions on the activity sheets.

Assessment

Collect activity sheets for grading.

Modifications/ Extensions

Choose your own variables. Allow students to select which variables they will test in this experiment. Variables may include temperature differences, saltwater concentration, or soil makeup.

Decomposition Experiment

Name: _____

Write your initial hypothesis:
Will fruit decompose more quickly in warm or cold weather? Why?

Will fruit decompose more quickly in wet or dry conditions? Why?

Procedure:
Each group will set up one cup per variable. Set up the cups as follows:

- Label the cups with masking tape.
- Fill a cup with ¼ cup of pea gravel.
- Add one piece of fruit to the cup.
- Cover the fruit with ¼ cup of pea gravel.
- Add water to the cup as necessary.
- Cover the cup with a piece of clear plastic wrap.
- Secure the plastic wrap with a rubber band.
- Place cup in the appropriate environmental condition.

Once a week, one group will open their cups and observe the fruit. Everyone in the class should record their observations of the fruit on the data sheet. Here are the variables for this experiment:

		Moisture		
		Wet	Moist	Dry
Temperature	Control	Add water to the top of the gravel. Room temperature.	Add water halfway to the top of the gravel. Room temperature.	Do not add water. Room temperature.
	Cold	Add water to the top of the gravel. Place in refrigerator.	Add water halfway to the top of the gravel. Place in refrigerator.	Do not add water. Place in refrigerator.
	Warm	Add water to the top of the gravel. Place outdoors or in greenhouse.	Add water halfway to the top of the gravel. Place outdoors or in greenhouse.	Do not add water. Place outdoors or in greenhouse.

Results and Conclusions:
At the end of the experiment, answer the following questions on a separate sheet of paper.

What were the results of the experiment?
In which conditions did the fruit decompose the fastest?
In which conditions did the fruit decompose slowest?

Were your original hypotheses correct?
How would your findings apply to the preservation of artifacts in different environments?
Where would artifacts be best preserved?

Decomposition Data Sheet

Name: _____

	Initial Observations				Final Observations
Date / Variable					

Lesson 2-2: Prehistoric Florida

Time Allotment
30-75 minutes

Materials
- Concept Map transparency (optional)

Per group:
- Set of clue cards

Per student:
- Large paper (11x17)

Advance Preparation
Make copies of the clue cards. Cut them out and place each set in an envelope with the set number on front.

Make a transparency of the Culture Concept Map or draw on the board.

Students will work in small groups.

Lesson Objectives
- Use logic and reasoning to develop hypotheses about Florida's prehistoric people based on a set of clues and questions.
- Develop a concept map to summarize key characteristics of Florida's Paleoindian and Archaic cultures.

Sunshine State Standards
SC.G.1.2.2 Adaptations and competition
SC.G.1.2.7 Environmental influences
SC.G.2.3.3 Resources and population
SC.H.1.2.2 Observation and analysis
SC.H.1.3.1 Knowledge changes
SC.H.3.2.2 Importance of data
SC.H.3.2.4 Problem solving
SS.A.2.3.4 Geographical factors
SS.A.2.4.1 Early humans
SS.B.2.3.7 Environmental conditions

Vocabulary
Archaic	Climate
Ice Age	Paleoindian

Background Information
Paleo-Indian describes Native Americans who lived in Florida between **12,000 and 8,500 years ago during the last Ice Age**. Glaciers covered much of North America, and sea levels were much lower than today (about 160 feet lower 10,000 years ago). Florida was about twice its current size. The climate was cooler and drier than today, and fresh water was relatively scarce on land. Paleoindians hunted large mammals that became extinct soon after the Ice Age ended, including mammoths, giant ground sloth, tapirs, and saber-tooth cats.

The **Archaic** time period, between **8,500 and 3,200 years ago**, showed a change in culture, tool technology, and settlement patterns. The climate was significantly warmer and wetter, sea levels rose, and water sources became more available.

Initial Discussion
1. Ask students what they know about the Ice Age. Encourage them to relate any knowledge from popular culture. Explain how Florida during and after the most recent Ice Age was somewhat different than other parts of the country.

2. Arrange students in groups of 4-5. Explain that they will be learning about prehistoric Florida, but they will need to use their logic and reasoning skills to infer information about Florida's prehistoric people. Work together and take turns reading each round. Take notes as you go along, because you will use this information to compare different cultures after the activity.

Hands-On Activity
3. Explain the rules of the activity first.
   a) **Clue keeper:** Each round, a different student will be the clue keeper. Open the envelope and read the info, clues, and at the end, the answers.
   b) **Read aloud:** The clue keeper begins by reading aloud the card entitled "What you need to know". Share this card with the rest of the group.

Lesson 2-2: Prehistoric Florida

c) **Ask Questions:** Next, the clue keeper will ask a series of "If… Then…" questions. The rest of the students should try to figure out the answer to question logically. When they have agreed on an answer, the clue keeper can let them know whether they are correct or incorrect.

d) **Read Clues:** If incorrect, the clue keeper can read the first clue and the group can reconsider their answer again. If they want another clue or answer incorrectly, the clue keeper can read the next clue, and so on, until the clues have been completed or the group has arrived at the expected conclusion.

e) **Review:** After each round, the teacher can review the answers and students can share the ideas they had in their groups. They will use this info for the next round.

f) **New Clue Keeper:** For the next round, a different student will be clue keeper.

4. Remind students that they need to take notes as they go through the rounds.

Relate Activity to Concept

5. Tell students they have just learned about two distinct cultures in Florida's history – Paleoindian and Archaic. Draw a timeline of these cultures on the board:
   a) Paleoindians: 12,000 - 8,500 years ago
   b) Archaic: 8,500 - 3,200 years ago.

6. Hand out the large paper. Challenge students to develop two concept maps, one for each of the two cultures studied in this lesson. Show the sample concept map on the overhead or draw it on the board.

7. You may have students work in their original groups, or you may have students work in smaller groups of 2-3 to create the maps.

8. Give students the guidelines for the concept maps.
   a) Write the name of each student in the group on the concept map.
   b) Each concept map should start with the name of the culture in the center of the paper.
   c) Each map should have at least 3-4 main branches coming off the starting point.
   d) Each branch should have at least 3-4 connecting statements.
   e) Statements may be connected to more than one other statement using a connecting line.

9. Review the statements shown in the sample concept map. They may use this as a starting point. They should use the information from their notes and discussion to complete their concept maps.

10. You may discuss the maps as a class or have students display their maps, if desired.

Assessment

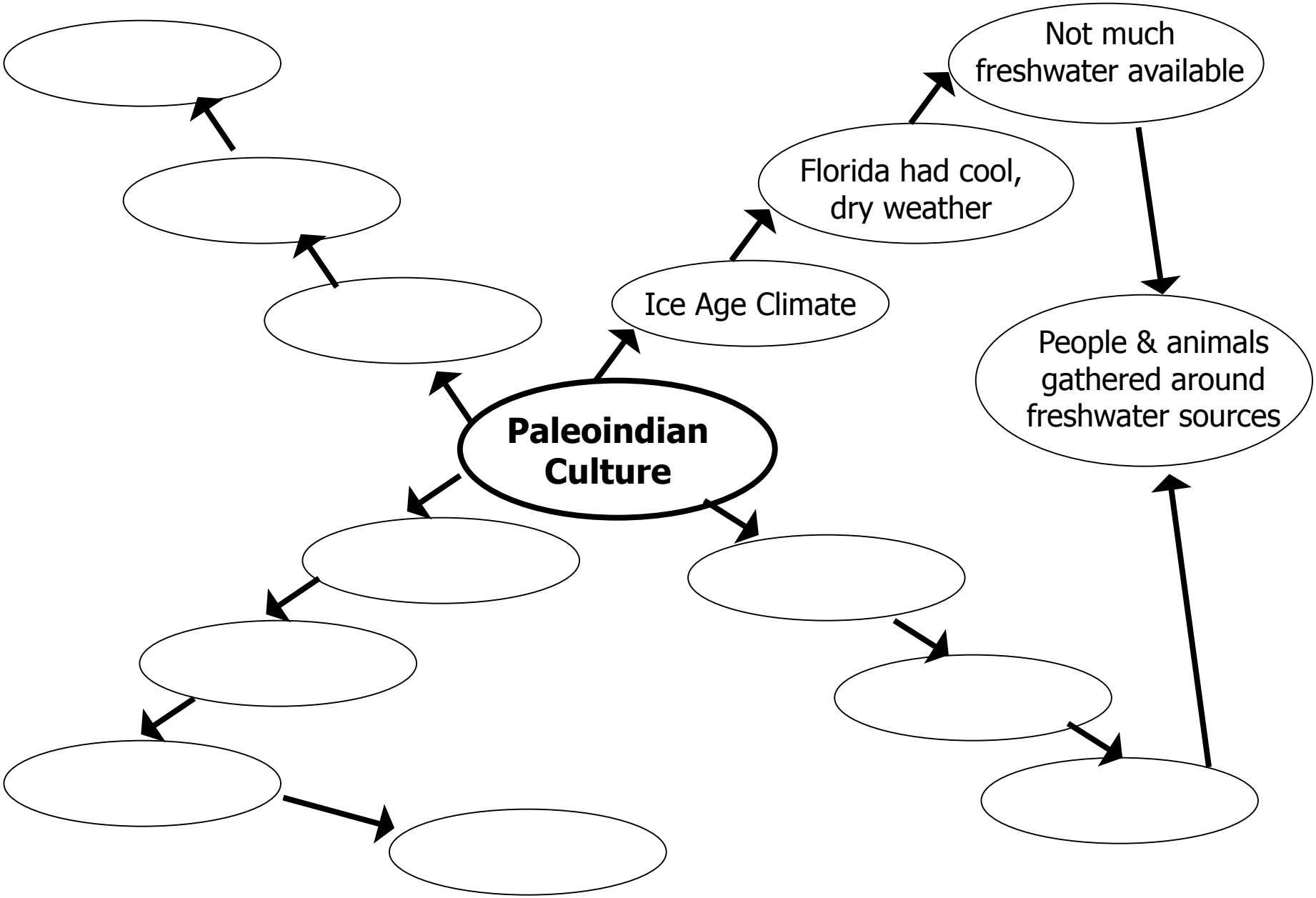
Collect the concept maps for grading. Use the guidelines above to score the maps.

Modifications/ Extensions

Provide starting points for the concept map. For students who need a little help, provide starting points for the concept maps to keep students on track.

Culture Concept Map

Names:



Clue Cards

#1a - Paleoindian

What you need to know:

What is an Ice Age? Ice Ages are intervals of time when large areas of the surface of the earth are covered with ice sheets (large continental glaciers). Ice Age often refers to the most recent glacial period the started about 70,000 years ago and ended about 10,000 years ago.

During the Ice Age, much of the Northern Hemisphere was covered in glaciers, some up to 1 mile high. The southern part of the United States, including Florida, was not covered in glaciers.

Today about 2% of the world's water is stored in the ice caps and in glaciers, but during the Ice Age, up to 30% of the worlds' water was trapped in glaciers.

Clue Cards

#1b - Paleoindian

If… Then… Questions

Q: If so much of the world's water was trapped in glaciers during the Ice Age,
Then how would the world's oceans be affected?

Hint #1: How much water would be in the ocean?

A: *Less water in the oceans = lower sea level*

Q: If there is less water in the ocean,
Then how would Florida be affected?

Hint #1: Where would the shorelines be?

A: *Lower sea level = Florida off-shore area exposed = Florida would be larger in land area*

Clue Cards

#2a - Paleoindian

What you need to know:

With the sea level drop, more of Florida's coastline was exposed, and the size of Florida almost doubled. The location of St. Petersburg was up to 50 miles from the shoreline during the Ice Age. With the sea level drop, groundwater levels on land dropped and freshwater was only found in a few deep lakes and sinkholes.

Clue Cards

#2b - Paleoindian

If… Then… Questions

Q: If there is less water on land,
Then how would the climate of Florida be affected?

Hint #1: Less water on land = less evaporation.
Hint #2: Less evaporation = fewer clouds.
Hint #3: Fewer clouds = less rain.

A: *Drier, cooler climate.*

Q: If the climate is dry and water is in short supply,
Then where would the animals be?
Then where would the people be?

A: *Both near freshwater sources, such as lakes and rivers.*

#2c - Paleoindian

If… Then… Questions

Q: If animals and people are near water holes,
Then how would it affect the relationship between people and animals?

Hint #1: What do animals eat?
Hint #2: What do people eat?
Hint #3: Who has the advantage?

A: *Animals could attack people, but people have tools for hunting the animals.*

#3a - Paleoindian

What you need to know:

During the Ice Age, many large animals (megafauna) dominated the landscape. Mammoths, giant ground sloths, saber-tooth cats, bison, tapirs, early horses, and giant tortoises were common. Smaller animals were also very common – deer, fish, turtles, raccoons, rabbits, frogs, and various birds.

People hunted almost any animal they could. Besides providing food, these animals provided fur, bones, antlers, teeth – all parts useful for clothing and tools. Many of the large animals migrated with the seasons, searching for new food and water sources.

Clue Cards

#3b - Paleoindian

If… Then… Questions

Q: If people are hunting animals that migrate,
Then what sort of lifestyle would they have?

Hint #1: Would they stay in one place?
Hint #2: Would they grow crops?
Hint #3: Would they have a lot of belongings?

A: *Hunter-gatherer lifestyle – they would be nomadic, with less permanent settlements since they are following the animals.*

Q: If people are hunting large animals,
Then how would it affect how they hunt?

Hint #1: Would it be easy or hard? Why?
Hint #2: How often would they have to hunt?
Hint #3: What kind of tools would they need?

A: *Hunting large animals may be more difficult, risky and dangerous. If they killed large animals, they would not need to hunt every day. They might use larger spears that could be thrown from a distance.*

Clue Cards

#3c - Paleoindian

If… Then… Questions

Q: If people are hunting animals near a sinkhole,
Then what kinds of artifacts or fossils would we expect to find there?

Hint #1: What kinds of animals did they hunt?
Hint #2: What kinds of tools did they use?

A: *We might expect to find animal bones, tusks, antlers, etc. as well as stone tools and spear tips.*

#4a - Archaic Indian

What you need to know:

The most recent Ice Age began to end about 18,000 years ago. The Earth's air temperature warmed about 8 degrees and the glaciers that covered the land began to melt. By 10,000 years ago, it had ended; some of the glaciers remain today near the North and South poles and at very high altitudes.

Clue Cards

#4b - Archaic Indian

If… Then… Questions

Q: If the glaciers (up to one mile high) melted,
Then how would the world's oceans be affected?

Hint #1: How much water would be in the ocean?

A: *More water in the oceans = higher sea level*

Q: If there is more water in the ocean,
Then how would Florida be affected?

Hint #1: Where would the water levels be?

A: *Higher sea level = Florida's shorelines would be underwater = Florida would be much smaller in land area but have more water on land.*

#4c - Archaic Indian

If… Then… Questions

Q: If there is more water on land,
Then how would the climate of Florida be affected?

Hint #1: More water on land = more evaporation.
Hint #2: More evaporation = more clouds.
Hint #3: More clouds = more rain.

A: *Warmer, wetter climate.*

Q: If the climate is warmer and wetter, with more available water,
Then how would it affect where people could live?

A: *People could live in more places, not just near a few freshwater lakes.*

#5a - Archaic Indian

What you need to know:

After the last Ice Age ended about 10,000 years ago, people could find freshwater in more places, so they spread out across Florida and their population grew.

As the population grew, hunting of large animals increased. Some animals, such as wooly mammoths and giant ground sloths, were well adapted for a cool climate and may have suffered due to the warmer climate. Overhunting combined with warmer climate led to the extinction of many animals, including the mammoth, giant ground sloth, and giant tortoise.

Smaller animals were still common – deer, fish, turtles, raccoons, rabbits, frogs, and various birds.

Clue Cards

#5b - Archaic Indian

If… Then… Questions

Q: If large animals were no longer common,
Then how would it affect what people ate?

A: *People would eat smaller animals more frequently.*

Q: If people are hunting small animals,
Then how would it affect how they hunt?

Hint #1: Would it be easy or hard? Why?
Hint #2: How often would they have to hunt?
Hint #3: What kind of tools would they need?

A: *Hunting a smaller animal may be easier, but people would have to hunt more frequently. Smaller spears and hunting tools would be needed.*

Clue Cards

#5c - Archaic Indian

If… Then… Questions

Q: If people are hunting small animals that could be found everywhere,
Then what sort of lifestyle would people have?

Hint #1: Would they stay in one place?
Hint #2: Where would they live?
Hint #3: Would they have a lot of belongings?

A: *People could have more permanent shelters and settlements. They could have more and larger tools since they are not moving around as much.*

Q: If people have more permanent settlements,
Then what kinds of artifacts or animal remains would we expect to find?

Hint #1: What kinds of animals did they hunt?
Hint #2: What kinds of tools did they use?

A: *We might expect to find animal bones, antlers, etc. as well as stone tools and spear tips. We might also find larger tools, such as axes.*

Lesson 2-3: Artifacts from Prehistoric Florida

Time Allotment
40-50 minutes

Materials
Per expert group (6 groups):
- Expert Artifact Cards
- Large plastic zipper bag (optional)

Per team group (10 groups):
- Team Analysis Sheets
- Artifact Sets

Advance Preparation
Make 2 copies of the Expert Artifact Cards. Cut the cards and divide them into 6 sets – 2 sets each for Stone, Wood and Animal Source Artifacts. Place in the zipper bag.

Make copies of the Team Analysis Sheets.

Make 10 copies of the Artifact Set Cards. You may copy one or both sets, depending on the time available.

Students will work in jigsaw groups.

Lesson Objectives
- Read about and examine images of artifacts and tools found from Paleoindian and Archaic time periods.
- Work in teams to determine if a set of artifacts came from Paleoindian or Archaic.

Sunshine State Standards
SC.H.1.2.2 Observation and analysis
SC.H.1.2.3 Working collaboratively
SC.H.1.2.4 Compare and contrast
SC.H.1.2.5 Models
SC.H.1.3.1 Knowledge changes
SC.H.1.3.2 Understand the inquiry process
SC.H.2.3.1 Patterns
SC.H.3.2.2 Importance of data
SC.H.3.2.4 Problem solving
SS.A.2.4.1 Early humans

Initial Discussion
1. Review Lesson 1-2: How to Read an Artifact with students. Recall how they examined four different artifacts and tried to infer their uses. They used skills of observation, but they did not have much background information on the cultures. Archaeologists use prior knowledge and expertise to make more accurate inferences.

2. Discuss with students how archaeologists need to learn as much as possible about what they might find *before* they dig, so that they have a basis for comparison and don't waste precious time.

3. Review the prior lesson in which students learned how prehistoric cultures and technologies change over time. For example, spear points changed depending on what people were hunting, and later people improved on previous designs.

4. Discuss how often archaeologists will work with other experts to better understand and interpret the artifacts they find.

Hands-On Activity
5. Give an overview of the activity. Students will become "experts" on different types of artifacts. First, they will study a set of artifacts in **"expert groups"**, and then they will move to a **"team group"**, bringing together different experts to study a new set of artifacts.

6. Divide students evenly into **6 expert groups**, two groups for each artifact type:
   a) Stone Artifacts
   b) Wood Artifacts
   c) Animal Source Artifacts

7. Explain that each expert group has a set of Expert Artifact Cards in a bag. Read through all of the cards and take notes. You have 15-20 minutes to become an "expert" on that type of artifact. Discuss your findings and ask questions, if needed. Compare and contrast the artifacts, and make sure you understand which culture the artifacts came from.

Lesson 2-3: Artifacts from Prehistoric Florida

8. Assign students to one of **10 team groups**, by counting off students in each expert group – 1 to 10. Each team group will have 3-4 students, with at least one student from each expert group. Students should move to sit with their new team groups.

9. Place the Expert Artifact Cards in designated areas around the room. Let students know that if they need to collect more information, they may return to their expert station. However, they may not bring the artifact cards back to their desks.

10. Hand out Artifact Set Cards and Team Analysis sheets. Explain the directions. Analyze a new set of artifacts, and work together as a team to draw conclusions about the culture from which they came. Record responses on the Analysis Sheet.

11. If time permits, the team groups can study a second set of artifacts. Depending on the level of your students, you may select one or both sets of artifacts for analysis. More advanced classes may be able to analyze both sets within the time period.

Relate Activity to Concept

12. Discuss the findings of the groups.

13. Discuss how archaeologists research cultures thoroughly before excavating any artifacts, to make better and more accurate observations and inferences.

Assessment

Collect the activity sheets for grading.

ARTIFACT SET ANSWERS

Artifact Set #1: Archaic

Stemmed Spear Point
Wooden Pestle
Shell Dipper
Wooden Atlatl (Spear Thrower)
Stone Scraper
Turtle Shell Bowl

Artifact Set #2: Paleoindian

Lanceolate Spear Point
Bone Pins
Egg Stone
Wooden Pointed Stake
Ivory Foreshaft
Wooden Buried Stake

Modifications/ Extensions

Assign students to specific groups. Create group number cards, labeled with the Expert group name and the Team group number. For example, "Stone 2 - C" for 2nd Stone Expert Group and Team Group C (of 10).

Provide questions for note taking and analysis. Depending on your students' levels, you may want to provide questions to prompt note taking and analysis in the Expert and Team Groups. Here are some possible questions:

a) Which artifacts came from the Paleoindian culture? Which artifacts came from the Archaic culture? How would you know?
b) Which artifacts could have come from either culture?
c) Which artifacts would have only one use? Which artifacts could have multiple uses?
d) Which artifacts would be easier for traveling? (Remember Paleoindians were semi-nomadic.)
e) Are there parts of tools that are missing? Are there artifacts, or parts of artifacts that would be less likely to be preserved?
f) Where would the raw materials for the artifacts come from? Would the raw materials be easy or difficult to access?

Expert Artifact Cards

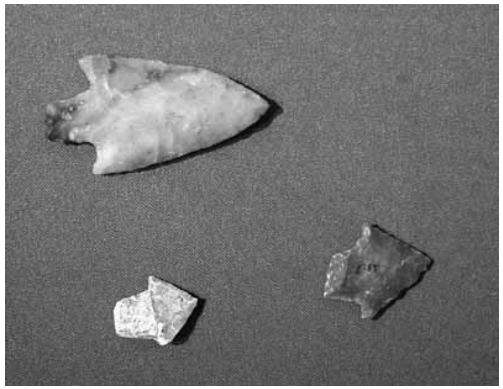
STONE ARTIFACTS:

General Information

Many stone artifacts in Florida are made from chert rock. Chert stays sharp for a long time, even after repeated use.

As tool technology developed, people learned that chert was even better after it had been heated. People would bury the chert pieces, build a fire on top, then let the chert cool. The silica in the rock would harden, like glass, making it easier to flake off pieces and making the edges sharper.

Durable rock like chert is relatively rare in Florida, so people must have traveled to find the chert to make tools. Because it was difficult to obtain, people would keep tools for a long period of time, reshaping them when they would break into new tools. Archaeologists find many reshaped tools, like the 2 smaller points in the photo below.



STONE ARTIFACTS:

Scraper / Blade

A variety of stone blades and scrapers are found in **both the Paleoindian and Archaic time periods**. Most stone tools were mounted onto handles, although a few were sharpened on one side only, leaving a dull side to hold onto.

Blades were used to carve tools out of wood or bone, and scrapers were probably used to scrape meat from the hides of animals. Many stone tools were probably used for several different purposes.

The stone scraper on the left was found at Little Salt Spring from the Archaic period. The tool on the right is a scraper with sharp points that may have also been used to punch holes.

Expert Artifact Cards

STONE ARTIFACTS:

Lanceolate Spear Point

The most easily recognizable Paleoindian artifacts in Florida are lanceolate spear points. The distinctive shape of these spear points - long, flat, lance-shaped - is typically **found from the Paleoindian period**, although they were sometimes used in later times. They were most often chipped from chert rock and were used to hunt large animals, such as mammoth, ground sloth, or bison.

Lanceolate spear points are typically 5-12 cm in length. They are designed to be attached to a sharpened piece of mammoth ivory, then attached to a wooden spear with leather straps.

While sometimes called 'arrow heads', these were *not* actually used for arrows. Native Americans did not use arrows until about 2,200 years ago.

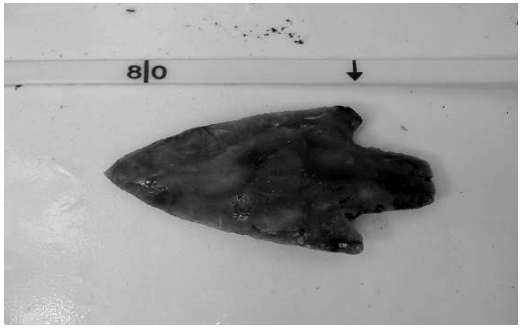
STONE ARTIFACTS:

Stemmed Spear Point

The stemmed spear point was **developed during the Archaic time period,** after the Lanceolate spear point of the Paleoindians.

These points are flattened with a short stem or base; they look like "Christmas trees". They were most often made from chert rock and ranged from 3-8 cm in length. The stems at the bottom made it easier to attaché to spears. They were stuck onto handles using sticky tar, then tied with leather or plant fiber straps.

While sometimes called 'arrow heads', these were *not* actually used for arrows. Native Americans did not use arrows until about 2,200 years ago.



Expert Artifact Cards

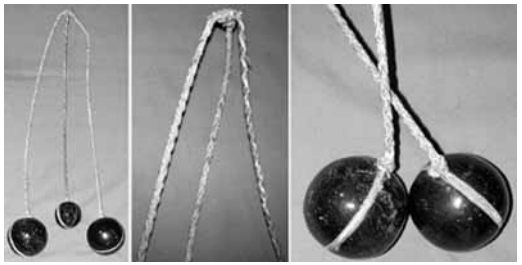
STONE ARTIFACTS:

Bola / Egg Stone

Stones ground into a spherical or egg shape have been **found from the Paleoindian period**, but not the Archaic period. They often have a groove down the middle of the stone.

It is not at all certain how these stones were used.

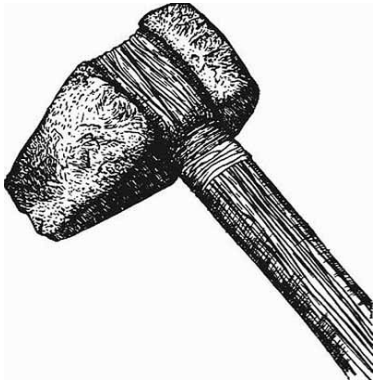
Some archaeologists suggest that they were tied to leather straps in groups of three to create a bola, shown below. Straps with stone weights attached to the ends can be thrown at animals to entangle them. When thrown, the bola would wrap around the legs of an animal, tripping it down.



STONE ARTIFACTS:

Stone Axe

Stone axes and wood choppers were heavy stone tools developed **during the Archaic time period**. During this time, people settled in more permanent locations and developed tools for chopping wood, like stone axes.



Most stone axes are found without the wooden handle, but the shape of the stone suggests they were attached to a handle using leather straps or plant fibers.

The smoothly ground stone axe shown on the right is a type rarely found in Florida. The sharp-edged tool shown below would more common.

Expert Artifact Cards

WOODEN ARTIFACTS:

General Information

Wooden artifacts were probably much more common than stone in prehistoric Florida because wood was more available. However, all wooden artifacts from the Paleoindian and Archaic time periods are extremely rare, because most have decomposed.

In sites where decomposition is slow, such as underwater sites with little oxygen, some wooden artifacts have been preserved. And organic artifacts like wood can be accurately dated using the carbon dating method.

At left is one of several wooden stakes found underwater at Little Salt Spring. It dates to 9,300 years ago (late Paleoindian period). Some archaeologists have hypothesized that these stakes may have been used to tie ropes along the edge of the sinkhole, so that people could climb down into the spring.

The rarity of wooden artifacts makes it difficult to pinpoint if it was only used in one time period. If a wooden artifact is found dating to a specific time period, we cannot say for certain that it was only used in that time period. It may be that the other wooden artifacts have decomposed or have not yet been discovered.

WOODEN ARTIFACTS:

Spears and Stakes

Wooden spears are found in **both the Paleoindian and Archaic time period**.

Spears are narrow, carved sticks, designed for throwing. Often one end of the spear was carved to more easily attach a stone or bone spear point. The photo at right shows modern-day replicas of spears with Paleoindian points.

Stakes are wooden tools carved with a purpose (as compared with a random stick). Some stakes are sharpened to a point for hunting animals (like spears, but not for throwing). Others are shorter and may have been used as equipment, such as tent stakes or stakes for ropes.

In Little Salt Spring, a wooden stake was found with the shell of a now-extinct giant tortoise. It appears that the stake had been driven through the underside shell of the tortoise to kill it. The wooden stake was carbon dated to about 12,000 years ago.

Expert Artifact Cards

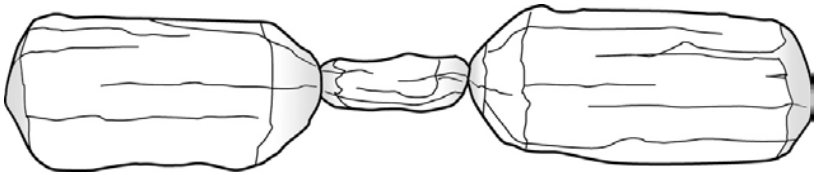
WOODEN ARTIFACTS:

Pestles / Pounding Sticks

Pestles are shaped pounding sticks. One or both ends are thick and heavy in order to pound or grind plants, nuts, or seeds.

The pestle illustrated below was one of several found at the Windover, an underwater Archaic site in central Florida. One pestle was found along with a turtle shell bowl. From examining the ends of the pestle, the archaeologists inferred how the pestle was made - probably made from a tree stump still attached to the ground.

Pestles were **possibly used in both the Paleoindian and Archaic time periods**, but so few have been found that **we cannot know for certain**.



WOODEN ARTIFACTS:

Bowls / Ladles

Wooden bowls and ladles have been **found at both Paleoindian and Archaic sites**.

A portion of what appears to be a log bowl carved from oak was preserved underwater in the Little Salt Spring site.

At Windover, an underwater Archaic site in central Florida, oak ladles were found, perhaps used for pouring water or food.

The mortar/bowl shown here was found in a cave in Texas dating to over 5,000 years ago. It illustrates one style of bowl that may have been made from wood.

Expert Artifact Cards

WOODEN ARTIFACTS:

Canoes and Paddles

Canoes have been found as early as the late Archaic time period, but paddle-like objects have been found even earlier.

Canoes were **possibly used in both the Paleoindian and Archaic time periods**, but so few have been found that **we cannot know for certain**.

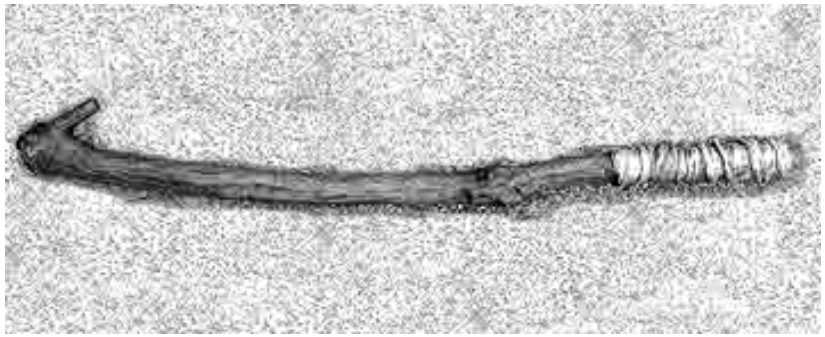
WOODEN ARTIFACTS:

Atlatls / Throwing Sticks

An atlatl is a tool used to hold and throw wooden spears. It may be made of wood, bone, or ivory. Wooden atlatls were **found in both Paleoindian and Archaic time periods**. By carbon dating the wooden artifacts, archaeologists can determine an exact age.

The atlatl allowed hunters to cast spears farther and with more force. An atlatl has a curved hook at one end to hold a longer spear. It often had a handle to make it easier to hold. Sometimes the atlatl has a stone weight attached to it to make the spear fly faster.

The atlatl below is a reproduction of a prehistoric spear thrower. It has a handle wrapped with cord or fabric, but many prehistoric people made more durable handles out of deer antler or mammoth tusk.



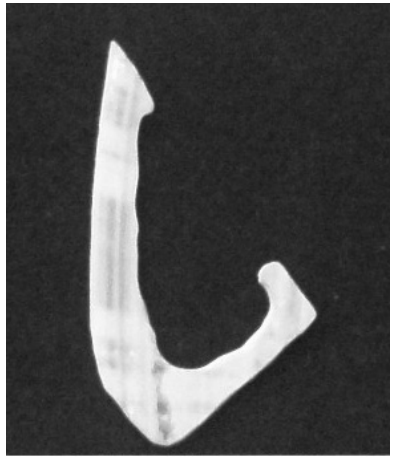
Expert Artifact Cards

ANIMAL SOURCE ARTIFACTS:

Shell Tools

Shell tools are found from both the Paleoindian and Archaic time periods. Made by chipping away the outer layers of shell and grinding the shell with stone, the conch dipper below would have been used like a modern ladle or bowl.

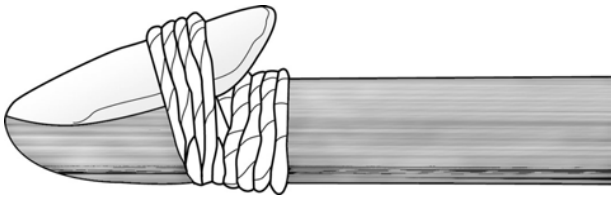
At right is a reproduction of a shell fishhook found from the Archaic time period. In Florida, shells were abundant, so many types of tools were made from this durable material.



ANIMAL SOURCE ARTIFACTS:

Atlatl Handles & Weights

An atlatl is a tool used to hold and throw wooden spears. It may be made of wood, bone, or ivory. The atlatl allowed hunters to cast spears farther and with more force. An atlatl has a curved hook at one end to hold a spear with a notched end (image below). It often had a handle to make it easier to hold.



Atlatls were **used in both Paleoindian and Archaic time periods**. However, atlatl parts **made from mammoth ivory are only found from the Paleoindian period**. Mammoths were extinct at the end of the Ice Age, so the Archaic people could not use the ivory tusks. The handle below, made of deer antler, was found underwater mat Little Salt Spring and dates to the about 7,500.

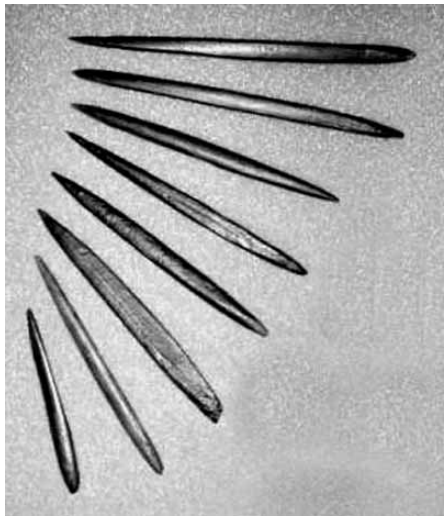
Expert Artifact Cards

ANIMAL SOURCE ARTIFACTS:

Bone Tools and Pins

Both Paleoindians and Archaic people made many kinds of tools from animal bones – birds, manatees, deer and others.

Bone pins (at left) may have been used for holding back animal skins during butchering or hide preparation. The bone tool on the right may have been used for poking holes in animal skins, but without a clear context, its true use is uncertain.



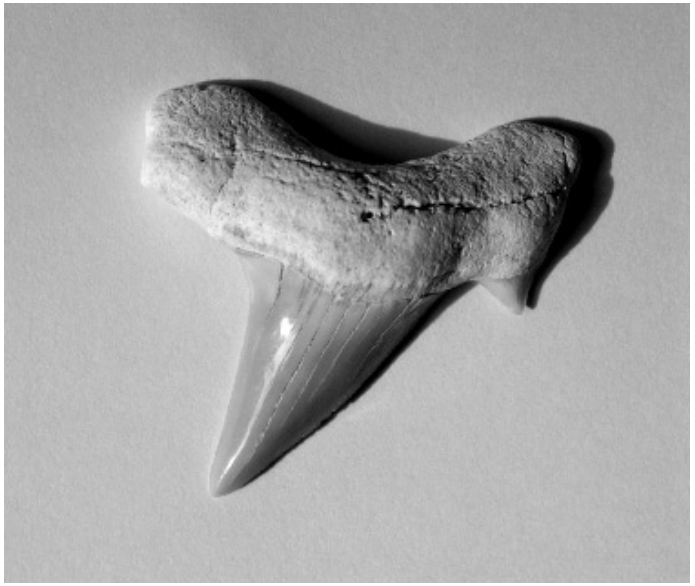
Many bone tools have been found with uncertain purpose. Some were probably used as scrapers or knives, since the unique shape of many bones makes it easier to form tools than with stone.

ANIMAL SOURCE ARTIFACTS:

Shark Teeth Tools

Shark teeth tools were have been found at several prehistoric sites and were probably used in **both the Paleoindian and Archaic periods.** Teeth were removed intact from shark jaws and were often mounted onto wooden handles. Shark teeth are naturally sharp and have serrated edges that make it useful for scraping and cutting.

Some shark teeth have been found with holes drilled at the top, including one that was mounted onto a wooden handle.



Expert Artifact Cards

ANIMAL SOURCE ARTIFACTS:

Ivory Spear Tip

Ivory from the tusks of mammoths was used by Paleoindians for a variety of tools. One unique tool was an ivory spear tip, or foreshaft. A long, pointed piece of ivory would be attached to the front of a wooden spear, sometimes with a spear point attached to the front tip. The hard, pointed ivory tip would puncture prey animals, especially those with thick skin.

Some ivory spear tips have been decorated by carving. Ivory can only be carved while it is fresh. If the ivory is dry, it becomes brittle and will crack. Mammoths became extinct before the Archaic time period. Any artifact made from mammoth ivory is **certainly from the Paleoindian time period**.

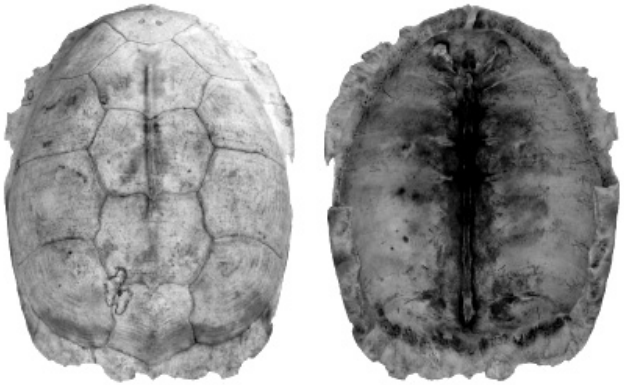
ANIMAL SOURCE ARTIFACTS:

Turtle Shell Containers

The top rounded shell of a turtle made a pre-formed bowl that has been found at several prehistoric sites in the Southeast. They were **possibly used in both the Paleoindian and Archaic periods**, but so few have been found that it is **not certain**.

These containers were made by splitting the top and bottom shells of a turtle. Archaeologists can tell the shells were purposefully made by people because of the cut marks found on the inside of the shell.

At Windover, an Archaic site found in a wetland in central Florida, wooden pestles were found along with turtle shell bowls. Pestles are shaped pounding sticks, so the find suggests that turtle shell bowls were used for grinding or pounding nuts or seeds.



Team Analysis Sheet

Name: _____

Sketch of Artifact	Possible Use	Culture?	Describe evidence.
		Paleoindian Archaic Uncertain	
		Paleoindian Archaic Uncertain	
		Paleoindian Archaic Uncertain	
		Paleoindian Archaic Uncertain	
		Paleoindian Archaic Uncertain	
		Paleoindian Archaic Uncertain	

Team Analysis Sheet

Name: _____

Team Group Number: _____ Artifact Set #: _____

Notes and Observations from the Artifact Set:

Questions from the Artifact Set:

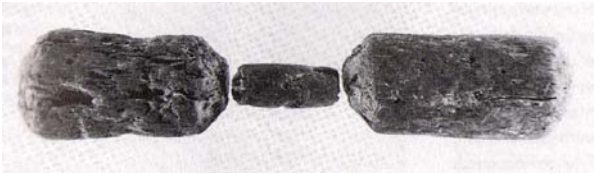
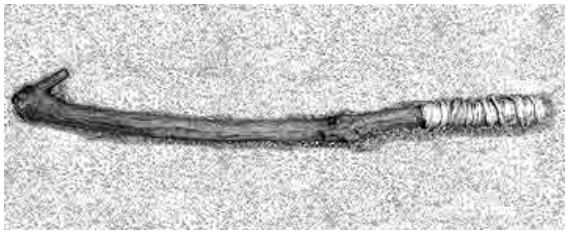
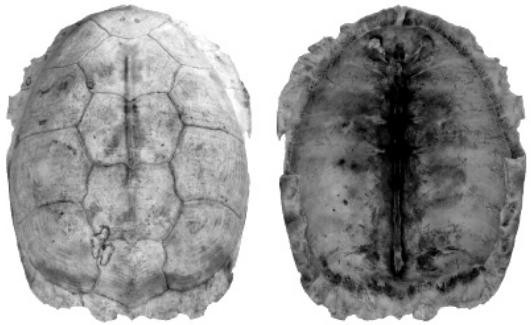
1. Which artifacts were easiest to identify? Which were more difficult? Why?

2. Do you think these artifacts come from the Paleoindian or the Archaic Indian culture?

3. Which artifacts or pieces of evidence strongly influenced your decision about the culture?

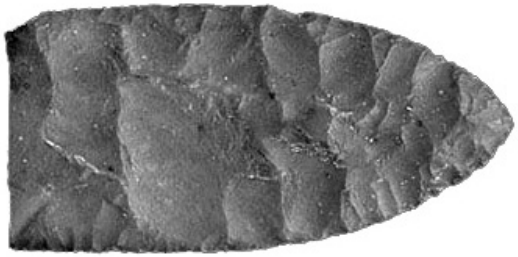
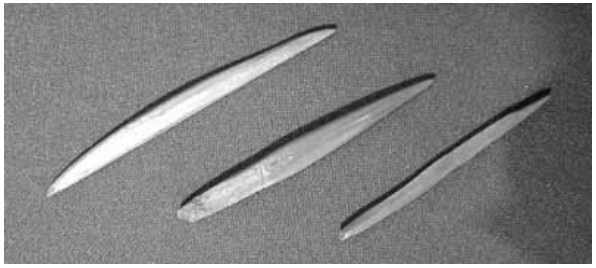
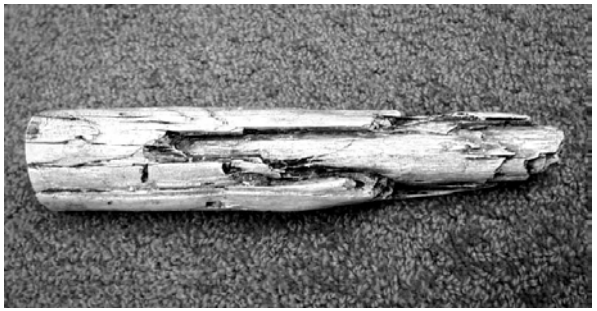
Artifact Set #1

As a team, use your expertise to identify the artifacts shown below. Then using the information from the expert groups, try to determine if this set of artifacts came from the Paleoindian or Archaic time period.

 *(made of chert rock)*	 *(made of oak wood)*	 *(made of conch shell)*
 *(made of wood)*	 *(made of chert rock)*	 *(made of turtle shell)*

Artifact Set #2

As a team, use your expertise to identify the artifacts shown below. Then using the information from the expert groups, try to determine if this set of artifacts came from the Paleoindian or Archaic time period.

 *(made of chert rock)*	 *(made of deer bone)*	 *(made of unknown stone)*
 *(made of wood)*	 *(made of mammoth ivory)*	 *(made of wood)*

Lesson 2-4: Visit Prehistoric Florida!

Time Allotment
30-50 minutes

Materials
Per student:
- Poster board or butcher paper
- Rubric/ Guidelines
- Colored pencils, markers, etc. (optional)
- Internet Resources sheet (optional)

Advance Preparation
Make copies of the rubric.

Students will work in groups of 2 to 5.

Lesson Objectives
- Utilize information learned in previous lessons to create a poster convincing people to visit prehistoric Florida in either the Paleoindian or Archaic time period.
- (Embedded assessment for this unit)

Sunshine State Standards
SC.G.1.2.7 Environmental influences
SC.G.2.3.3 Resources and population
LA.7.4.2.2 Visual aids to organize info
LA.910.3.5.2 Using graphics/design principles
SS.A.2.3.4 Geographical factors
SS.A.2.4.1 Early humans
SS.B.2.3.7 Environmental conditions

Initial Discussion
1. Review the two prehistoric Florida cultures they have studied in this unit – the Paleoindian and Archaic culture. These cultures from 10,000 years and 5,000 years ago respectively experienced different climates, different landscapes, and different animals.

2. Tell students they will choose one of those time periods – if people had the opportunity to visit Florida during one of these times, which would be better and why?

3. Students will create a poster to convince future time travelers to visit prehistoric Florida during their preferred time period.

Hands-On Activity
4. Hand out rubrics and discuss expectations. The rubric includes guidelines for poster elements, writing, and use of class time.

5. Arrange students in groups and hand out poster paper, colored pencils, etc.

6. Students may use information learned in the previous unit. You may choose to have students do additional research online using some of the web pages listed on the Internet Resources sheet.

7. Required elements include:
   - Description of climate at the time, compared to today's climate
   - Description of Florida's geography (water level, coastlines, etc.)
   - List of 5 animals found then, compared to today
   - Description of prehistoric cultures, including what they ate

8. Students may work in class or as homework.

Relate Activity to Concept
9. Have students present their posters and/or display them for the class.

Assessment
Use the rubric to grade posters.

Prehistoric Florida Poster Rubric

Required Elements of the Poster:

1. Describe one prehistoric culture (Paleoindian or Archaic), including at least 3 artifacts, how they lived, and what they ate.
2. Describe the climate at the time, compared to today's climate.
3. Describe Florida's geography (water level, coastlines, etc.), compared to today.
4. List 5 animals found at the time, compared to today.

	4	3	2	1 or 0
Required Elements	All required elements are presented, as well as additional information.	All required elements are included on the poster.	All but 1 of the required elements are included on the poster.	Several required elements were missing.
Labels and Graphics	All items of importance are clearly labeled with labels that can be read from at least 4 ft away. Graphics are related to the topic and make it easier to understand.	Most items (75%) of importance are clearly labeled with labels that can be read from at least 4 ft away. Graphics are related to the topic and make it easier to understand.	Some items (50%) of importance are clearly labeled with labels that can be read from at least 4 ft away. Most graphics are related to the topic.	Labels are too small or no important items are labeled. Graphics may not have been used, or are too small or unrelated to the topic.
Grammar	Capitalization, punctuation, and grammar are correct throughout the poster.	There are 1-2 mistakes in capitalization, punctuation, or grammar.	There are 3-4 mistakes in capitalization, punctuation, or grammar.	There are more than 4 mistakes in capitalization, punctuation, or grammar.
Attractiveness	The poster is exceptionally attractive in terms of design, layout and neatness.	The poster is attractive in terms of design, layout and neatness.	The poster is acceptably attractive, though it may be messy or disorganized.	The poster is distractingly messy or very poorly designed. Not attractive.
Knowledge Gained	Student can accurately answer all questions related to facts in the poster.	Student can accurately answer most questions related to facts in the poster.	Student can accurately answer 75% of questions related to facts in the poster.	Student appears to have insufficient knowledge about the facts in the poster.
Use of Class Time	Student used time well during each class period. Focused on getting the job done and never distracted others.	Student used time well during each class period. Usually focused on getting the job done and never distracted others.	Student used some time well during each class period. There was some focus on getting the job done but may have distracted others.	Student did not use class time well to focus on the project, or repeatedly distracted others.

Module 3: Studying Florida's Modern History in Tampa Bay
Introduction

Archaeological Techniques

In archaeology, context refers to the relationship artifacts have to one another, as well as the situation in which they were found. Context provides important clues about the artifact and what it was used for. When removing artifacts from a site, it is essential to record the exact location of the artifacts for future study. Many underwater archaeologists leave underwater sites as they are, choosing to not remove artifacts, due to difficulty in preserving such artifacts. It is even more important to document underwater artifacts for future study.

Archaeologists create detailed maps of an archaeological site, called site plans. To make the site plans accurate, they may set up a baseline – a line marked in regular increments that stretches from one end of the site to the other from which measurements may be taken. They may also use a grid system, by setting up a series of baselines and perhaps smaller portable grids that are laid upon the actual site.

One important technique used by archaeologists to create an accurate site plan is triangulation. With triangulation, measurements are taken from an unknown point to three known points. The known points may be fixed features or may be specific points along a baseline. When creating the site plan on paper, the archaeologist will use a compass to draw an arc from each known point to the area of the unknown point. The intersection of the arcs will be the exact location of the unknown point.

When mapping a three-dimensional site, archaeologists need to also record a vertical reference point, in relation to a fixed point. For example, terrestrial archaeologists will record elevation above sea level as they excavate a leveled site. For underwater archaeologists, this can be more difficult, especially when dealing with deep water, tidal influences, or a sloping site. In these situations, archaeologists will measure depth using a fixed point - which may even be a temporarily fixed point in the form of a stake in the ground. A leveled line (datum line) is attached to the point and is used as the baseline for vertical distances (measured as depth below datum). As long as all points are measured in relation to the datum line, a 3-dimensional map created from the measurements will be accurate.

Tampa Bay Shipwreck Survey

The Florida Aquarium began to survey Tampa Bay for historic shipwrecks in August of 2006 with funding from the Florida Division of Historic Resources and cooperation with Southeastern Archaeological Services and Tidewater Atlantic Research.

The Aquarium researched likely locations using archival records, and then began surveying those locations using remote sensing equipment. In 2006 and 2007, maritime archaeologists and volunteer divers logged many hours diving and documenting several potential archaeological sites, including the Kate Dale found in the Hillsborough River and the U.S.S. Narcissus found off Egmont Key near St. Petersburg.

Two articles are included as background information for this module. One describes the exploration of the Kate Dale, a blockade-running sloop burned during the Civil War for trying to transport supplies to the Confederates. The other article describes the U.S.S. Narcissus, which exploded off Egmont Key after the end of the Civil War, killing all onboard.

Additional background information is included in the lessons.

Long-Lost Ship May Surrender Civil War Secrets

By KEITH MORELLI, The Tampa Tribune, Friday May 23, 2008

TAMPA - On an October night 145 years ago, the Kate Dale, a sleek sloop made of live oak and pine, lay at anchor beneath the cypress trees in the Hillsborough River just north of what is now Lowry Park, its hold full of cotton for a stealthy voyage to Cuba.

The Confederate States used the boat, owned by Tampa maritime pioneer Capt. James McKay, to ship stores to Caribbean ports to fund the Confederacy, which a few months earlier had suffered a crippling defeat at the small Pennsylvania town of Gettysburg. While Tampa did not play a large part in the cause, rebel actions here did not go unnoticed by the Union.

So, in the dead of night on Oct. 16, 1863, while the Yankees shelled Fort Brooke near downtown Tampa as a diversion, a kind of special operations force of about 100 federal troops was put ashore near Ballast Point. They made their way north along the river to where the Kate Dale and another blockade runner named the Scottish Chief were moored. A skirmish ensued and the two vessels were overrun, burned and sunk.

A lot of murky water has passed over the Kate Dale's remains since that night, but not enough to dim the attention of Billy Morris, an archaeologist in charge of researching the wreckage. On Thursday, Morris, dressed in a black wetsuit, barked orders to a handful of divers treading water.

For years, mystery has surrounded oak ribs of the 19th century sloop, reaching as they have for the surface, sometimes poking through during low tide. Most people only ever imagined they were the remains of an old dock. Now, Morris is betting they are not.

"I would never say that I'm 100 percent sure," he said, "but it's probably the blockade runner Kate Dale." That's about as definitive as he will get on the record, but the way he says it lets you know what he thinks.

Of course, for river rats who have lived here for generations, the revelation that there is a sunken Civil War-era ship at the Lowry Park site is nothing new at all. The Tampa Tribune wrote in 1982 about Calvin "Poppa" Taylor, a treasure hunter of sorts who claimed to have gotten inside information from a descendent of McKay, revealing the location of sunken treasure. The story includes a photo of Taylor posing with a steering wheel he says was from the Kate Dale or the Scottish Chief. Taylor said he got the wheel during a dive he made in the 1960s, and for years told everyone he had found the Scottish Chief.

"You'll find them out there, sunk deep in the mud and the silt," Taylor told the Tribune at the time. "The hulls are still there, buried along the bank. But it's just too damn dirty to see."

Researchers were aware of Taylor's claims and used that information, along with information from people living along the river and data collected from sophisticated sonar equipment, to pinpoint where the ship's wreckage lies, said Tom Wagner, spokesman for The Florida Aquarium, which is coordinating funding for the archaeological project.

Beams Seen Before

The Kate Dale and the Scottish Chief belonged to Capt. McKay, for whom McKay Bay is named, and both were in the business of smuggling, most likely cotton, to help operate and provision the confederacy, Morris said.

Nobody knows for sure, but legend has it that the Scottish Chief was towed downriver to the bay where its steam engine was pulled and installed in another ship. The Kate Dale, burned hull and all, was left behind to begin its long descent into the muck of the river bottom, less than a half mile north of the Sligh Avenue bridge.

Long-Lost Ship May Surrender Civil War Secrets, p. 2

About a third of the 80-foot-long vessel is there, lying across the bottom in depths from just a few feet along the banks to about 15 feet in the middle. The rest of the vessel could have rotted away, or been carried away by the currents, or been salvaged by residents, Morris said.

The find is significant because it's the only blockade runner ever found in Florida's waters. Federal warships hovered around prominent southern ports during the war, trying to strangle the South's economy by attacking merchant ships and seizing cargo or sinking them. It shows that there was Civil War activity going on around here," he said. "This is pretty significant."

For years, rivergoers and people living along the banks noticed beams sticking up during low tide, but thought nothing of it. Two years ago, as part of an archaeology grant, The Florida Aquarium launched an underwater mapping project that included researching any sunken vessels of historical significance.

Archaeologists mapped much of the bay and the Hillsborough River up to the spillway near Rowlett Park, Morris said. This was the only find, he said. From the beginning, he suspected it was the Kate Dale.

It was where available records said it was sunk and the submerged hull shows evidence of burning, he said.

Boat Will Remain In River

During the next two weeks, divers will map the vessel in excruciating detail, taking tedious-but-exact measurements. Thursday, they were vacuuming silt from one section to see what was underneath. Visibility in the river at that spot is zero, Morris said.

Divers have to measure beams with tapes and then surface to see exactly what the dimensions are. It's demanding, often boring work, but they're buoyed by uncovering something of historical significance, he said.

There are no immediate plans to pull the delicate rotting hull out of the muck. After taking measurements, recording information and checking historical and nautical records, the archaeologists will replace the mud, Morris said. The hull will remain where it has been for nearly a century and a half.

But the story of the Kate Dale will live on, most likely in a colorful exhibit at the aquarium two to three years from now, said spokesman Tom Wagner. "We are going to leave it where it is," Wagner said. "It's too costly to pull it up and maintain it."

The display will tell the tale of the Kate Dale and other boats that gave Tampa a wartime reputation as a port for blockade runners. The exhibit will also feature the USS Narcissus, an 82-foot Union tugboat-turned-warship that sank near Egmont Key less than a year after the Civil War ended. A boiler exploded and 29 people died.

It could be a new chapter for the aquarium, he said. "This will show the historically significant role of Tampa during the Civil War."

Researcher Michael Messano contributed to this report. Reporter Keith Morelli can be reached at (813) 259-7760 or kmorelli@tampatrib.com.

Diving Into History:
Archaeologists are exploring the USS Narcissus, a Civil War-era military tugboat that sank in 1866.

By STEVE KORNACKI, The Tampa Tribune, Sunday June 10, 2007

EGMONT KEY - There is little sign of the horror U.S. Navy crewmembers experienced offshore of this island on Jan. 4, 1866, when the Union Civil War tugboat the USS Narcissus ran into a shoal during a storm and exploded.

All 26 perished and were never found. However, the remains of the 101-ton tug are nestled above and beneath the ever-churning sands northwest of Egmont Key.

The vessel's shattered steam engine boiler - which burst like a bomb when the cold Gulf waters hit it - is about three miles from shore, along with its A-frame engine, drive shaft, huge propeller, double walled boiler and other parts now covered by barnacles, sponges, algae and worms.

The tugboat graveyard, home to feeding saltwater fish for the past 141 years, now has frequent visitors wearing dive tanks, masks and wet suits. Divers from The Florida Aquarium have been studying it since last summer when the downtown Tampa aquarium received grant money from the state's Bureau of Historic Preservation.

Mike Terrell, the aquarium's dive training coordinator, is supervising the project along with contracted St. Augustine archaeologist John W. "Billy" Morris. Terrell says The Florida Aquarium plans to replicate the wreckage for display in its 93,000-gallon Shark Bay exhibit. They also hope to have it declared an underwater archaeological preserve by the state.

"There is so little Civil War history in this state," Terrell said, "and now everyone will be able to see some of it without getting wet." For now, the privilege of perusing the boat is only for the aquarium's staff and volunteer divers. On Wednesday, a group of six ventured out to check its wreckage and another sunken vessel within a mile of it.

As the 25-foot Miss Bee Gee research boat motored past Egmont Key, Morris squinted into the rushing wind and raised his voice, saying, "Egmont looked just like that when the Narcissus went down, only the waters were much rougher. The lighthouse was there, but the light was turned out."

Confederates had turned off the lighthouse's beacon to prevent its use by Union blockade purposes. Had the light provided better guidance into Tampa Bay, would the Narcissus have missed the shoal? We'll never know.

'Damn The Torpedoes!'

The 82-foot tug, named the Mary Cook until commissioned by the Navy, took part in the Battle of Mobile Bay, where Union Adm. David Farragut exclaimed, "Damn the torpedoes! Full speed ahead!"

The Narcissus survived that naval operation and a blockade of New Orleans, but was sunk by a Confederate torpedo - the term then for exploding mines - in Mobile Bay on Dec. 7, 1864. It went down in 15 minutes but no lives were lost. The Narcissus was raised and taken to Pensacola for repairs. It finished out the war there before departing to New York on New Year's Day 1866 for decommissioning.

Two days later, the tug exploded in one of the worst U.S. Navy disasters up to that point. Morris, who specializes in underwater ship archaeology, said he was part of a Florida Bureau of Archaeological Research crew that discovered the Narcissus in 1992. When he returned last August, Morris was surprised to find how much more of the remains had become exposed.

Diving Into History, p.2

"The hurricanes from a couple years ago had something to do with it," Morris said, "but it was left more exposed mostly by the recent dredgings in the area. That all moved away 10 feet of sand.

"I'm fascinated by how intact the engine is. The details of it are spectacular. It was an inverted single-cylinder engine, and it fell over the port side upon the explosion. When we found this much of it preserved, I suggested we replicate it."

Photographs and precise measurements have been taken to assure the fiberglass version of the Narcissus is just like the actual wreckage.

An Accurate Depiction

The undisturbed pieces of the tug were mapped by staff divers and 10 trained volunteers who averaged 11 dives each. Morris said the remains belong to the Navy, and no excavating is allowed.

“When you are down there, you are focused on the task at hand," Morris said. "But on the way back in the boat, it hits you what you've just seen and touched."

Morris has been to the wreckage more than 50 times. He became hooked on underwater archaeology as a teenager in Wilmington, N.C., when the USS Monitor, the storied Civil War ironclad, was discovered in 1973.

"I fell in love with it and have done lots of Civil War naval archaeology," he said.

"Billy knows so much about ship construction that it's crazy," Terrell said.

Each of the dozens of dives to the Narcissus led by Morris followed the same procedures and disciplines. After ship captain and aquarium staff diver supervisor Jason Minnear dropped anchor at the global positioning system coordinates for the Narcissus, Morris did a back roll off the research boat and dived to locate it before calling for the rest.

Other divers, each with a predetermined role in that day's plotting, took to the water with tape measures, level lines, plumb bobs, compasses, pencils and a slate covered with a special plastic paper to record details.

"These are field trips that people pay to go out on with National Geographic," said Dan Rosenthal of Tampa, a trained aquarium diving volunteer. "This is the kind of thing you read about in magazines."

Their efforts eventually will bring the Narcissus to the public with the aquarium exhibit, which Terrell says should be realized by late 2008 or in 2009. He also hopes that the site becomes the 14th shipwreck site recognized by the state as an underwater archaeological preserve.

Terrell said, "It's not skeletons hanging on the ship's wheel, the vision of shipwrecks for most people. But you go down there or see photos of the ship, and you can be told a very dramatic, very engaging story."

Reporter Steve Kornacki can be reached at (813) 731-8170 or skornacki@tampatrib.com.

Lesson 3-1: Remote Sensing Technology

Time Allotment
20-30 minutes

Materials
- Remote Sensing Images transparency

Soundings box preparation (see Advance Prep):
- Compass point (metal)
- Masking tape
- Fine-point marker
- Grid Pattern (optional)

Per student:
- "Diving into History" (Narcissus article)

Per pair:
- One children's shoebox with lid
- 2-3 small objects, such as toy boats, building blocks, rocks, etc.
- Modeling clay (optional)
- Wooden skewer (at least 4" longer than the height of the shoebox)
- Sounding Box activity sheet

Advance Preparation
Make copies of the activity sheet and make a transparency of the Remote Sensing Images. (see Modifications).

Students will work in pairs.

Note: Prepare the boxes ahead of time yourself, or have students help with some or all of the preparation. Once the boxes are made, they may be used repeatedly with multiple classes.

Make the soundings boxes:
1. Poke holes in the shoebox lids using the compass point. Use the grid sheet provided to align the holes.
2. Use modeling clay to cover the bottom surface of the box, with an irregular topography (optional).
3. Use masking tape to fasten the toy boats, etc. to the bottom of the box.
4. Tape the lid on the shoebox so that the contents cannot be seen.
5. Mark wooden skewers at 1 cm increments with the marker.

Lesson Objectives
- Discuss the history of the Narcissus shipwreck.
- Compare sonar images with a site map and photos of a shipwreck site.
- Use a soundings box to model a point-by-point remote sensing technology to locate objects and map findings on graph paper.

Sunshine State Standards
SC.C.1.3.2 Wave energy
SC.C.2.3.1 Forces
SC.H.1.2.3 Working collaboratively
SC.H.1.2.5 Models
SC.H.3.2.2 Importance of data
SC.912.N.1.1 Scientific Investigation
MA.4.G.5.3 Two-dimensional representation
MA.5.G.5.3 Measurement
SS.B.1.4.2 Comparing maps

Vocabulary

Global Positioning System	Sonar
Hydrography	Soundings
Lead lines	Topography

Background Information
Hydrography ("hydro" = water and "graphy" = writing) is the science of measuring and describing the physical features of bodies of water, including underwater **topography**, depths of coastal waters, and the shape of coastlines. The most basic job of a hydrographer is taking measurements of water depth, called "**soundings**".

For many years, hydrographers used **lead lines** (sounds like "red lines"), ropes marked at regular intervals with a 10-lb lead weight tied to the end. The hydrographer lowers the line into the water until the weight reaches the bottom. Then they measure the length of the line, using markings on the line. Soundings were accurate, but took a lot of time and measured only single points of the sea bottom. Many measurements are needed to accurately survey a given area.

Modern hydrographers use **sonar** and satellite-based global positioning systems to produce detailed maps of the seafloor. Sonar systems

transmit sound pulses through the water; the sound waves reflect off the bottom of the seafloor and are detected by a receiver. A sidescan sonar transmits a fan-shaped signal that sweeps the seafloor. The strength of the returning echo is recorded and analyzed by a computer to create a "picture" of the seafloor. Global positioning system (GPS) is a way to track specific locations using signals from a satellite. Hydrographers use GPS to develop detailed 3-dimensional maps with exact coordinates.

When scientists identify a site of interest, divers or remote underwater vehicles may take underwater photographs. These can be compared with remote sensing images, but often provide very different information.

Initial Discussion

1. Have the students read the article, "Diving into History", or tell the story verbally in class. The Narcissus wreck has been uncovered in recent years, allowing archaeologists to more accurately map and understand the site.

2. Describe the technology of **soundings**, a method of measuring ocean depths. Discuss the technology of **sonar**. Sonar technology transmits sound pulses through the water; the sound waves reflect off the bottom of the seafloor and are detected by a receiver. The strength of the returning echo is recorded and analyzed by a computer to create a "picture" of the seafloor.

3. Show students the overhead or images of the Narcissus. Ask students to compare images from sonar with the site map and the photographs. What kind of information do we get from each kind of image?

4. Tell students that marine scientists and archaeologists will begin research by using sonar to locate specific areas to study. Then they can dive the site to map the artifacts and take photographs.

Hands-On Activity

5. Explain the activity. Students will work in pairs to take depth measurements using a soundings box model. The box represents the sampling area, the lid represents the ocean surface through which we cannot see to the bottom, and the skewer represents a lead line (or sound waves reflecting off the bottom). Students alternate taking soundings and recording depth measurements.

6. Take soundings by gently pushing the skewer through the holes until it hits the bottom. Hold your finger at the surface of the box (the lid) and pull the skewer out. Read the depth out loud, as your partner records the depth on the map.

7. After half the measurements have been taken, switch roles with your partner.

8. Outline the features of the model seafloor on the grid. Can you identify any areas or objects of interest? Once the Soundings Box Map is completed, remove the filter from the top of the box to see what's below.

Relate Activity to Concept

9. When underwater archaeologists are searching for shipwrecks or other underwater sites, they will first survey the area. They will take measurements of the seafloor to find any unusual objects above the seafloor. After they have identified potential sites, they will dive to more carefully examine their findings.

Assessment

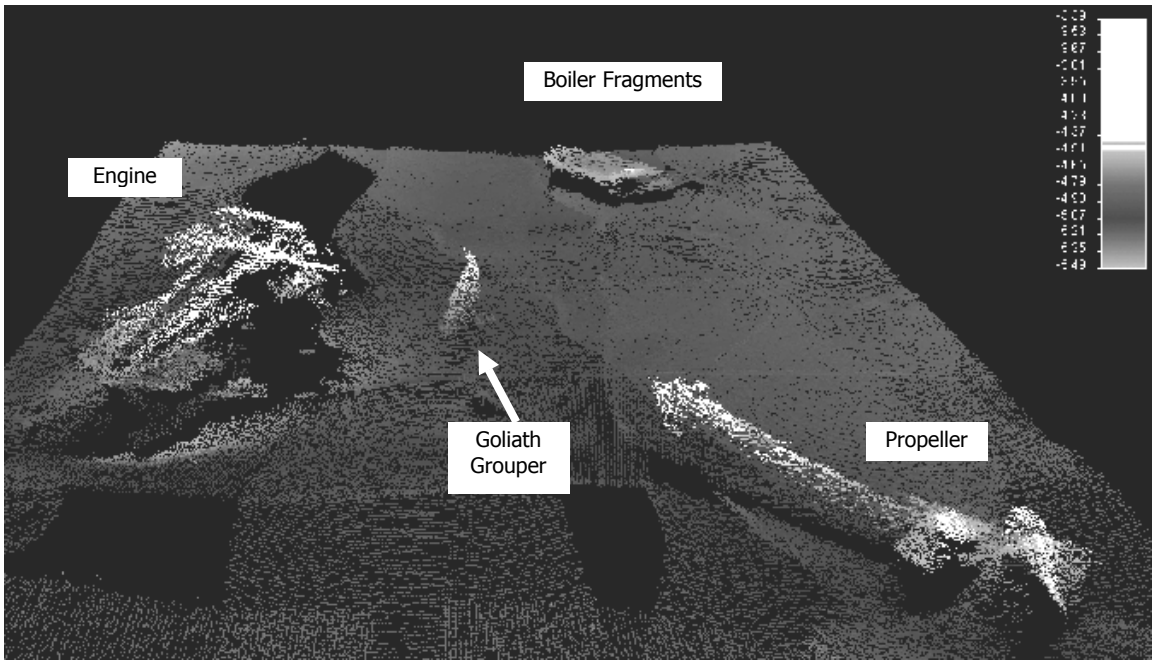
Collect activity sheets for grading.

Adapted from:

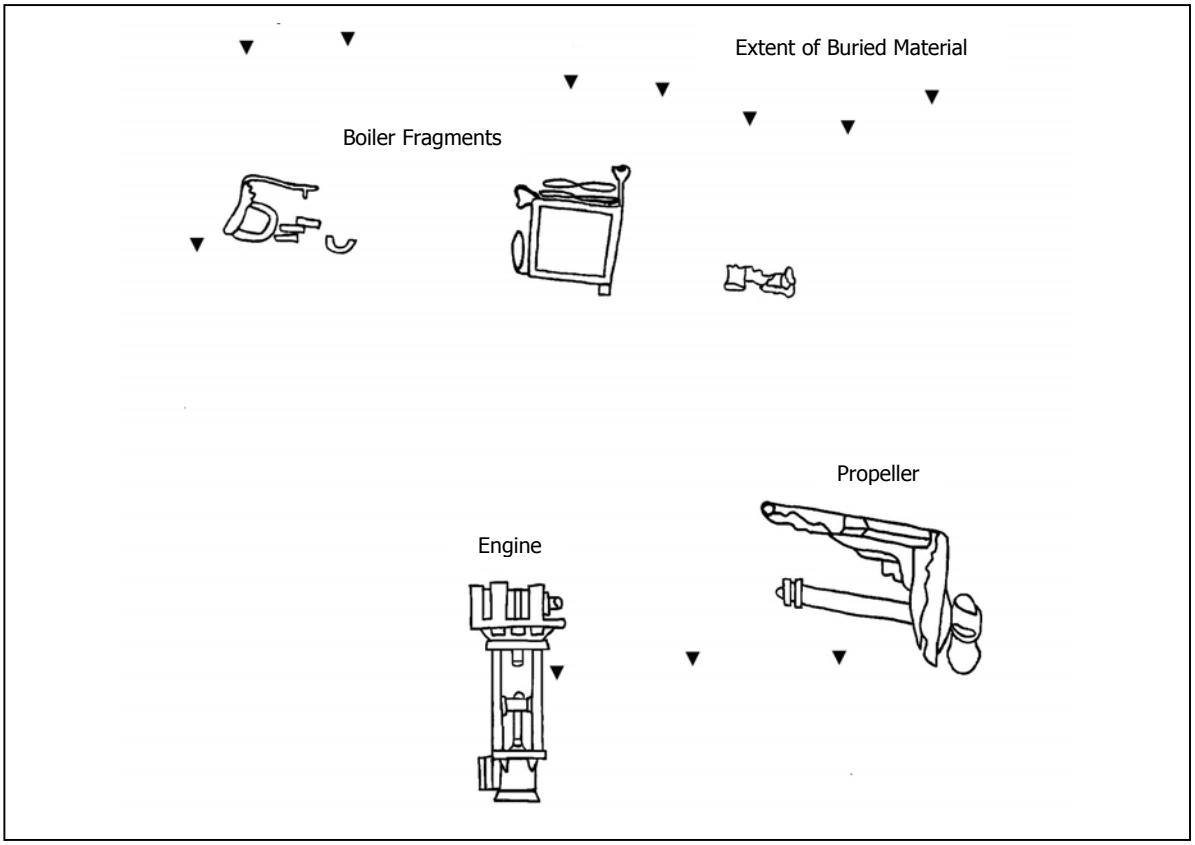
- "The Water Writers" National Oceanic and Atmospheric Administration. Explore the Earth. http://celebrating200years.noaa.gov/edufun/book/welcome.html
- "See that Sound" NOAA. Marine Navigation. http://oceanservice.noaa.gov/education/classroom/lessons/23_hydrosurvey_see.pdf

Remote Sensing Images

Sonar Image of the U.S.S. Narcissus (*Note the giant Goliath Grouper in the center of the image.*)

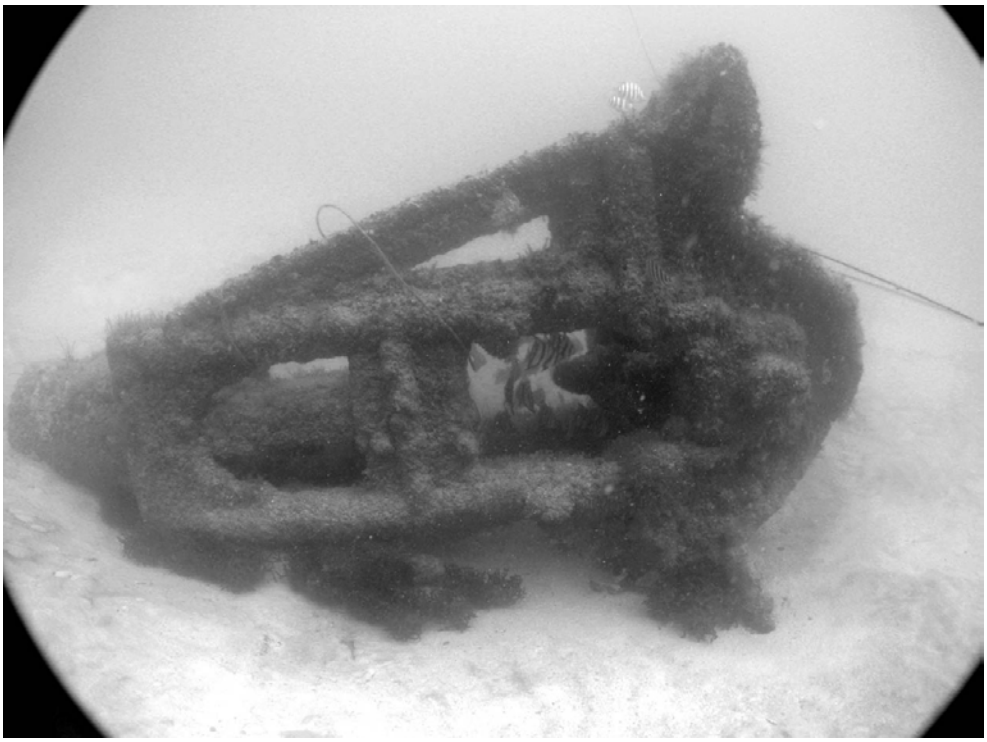


Site Map of the U.S.S. Narcissus *(Triangles indicate the edges of the ship buried in the sand.)*



Photographs of the U.S.S. Narcissus

U.S.S. Narcissus Engine



U.S.S. Narcissus Propeller

(*Note: Since these photographs were taken by a diver, these are not remote sensing images.*)

Soundings Box Map

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3											
4											
5											
6											
7											
8											

Soundings Box Grid Pattern – 2 cm increments

Lesson 3-2: Archaeological Techniques in the Classroom

Time Allotment
2 or 3 – 20-30 minutes class sessions

Materials
- Scale Drawing and Triangulation overhead (Sample Diagram and Student Page)
- Artifact copies

Per group:
- Measuring tape

Per student:
- Scale Drawing and Triangulation sheet
- Graph paper
- Ruler
- Compass

Advance Preparation
Make copies of activity sheets and overhead.

Copy one (or two) sets of artifacts and place around the room in three general areas as follows (see Modifications):

A. Stone scraper, Bone tool, Spear point

B. Oyster shell, Shell dipper, Shell fishhook

C. Decorated Deer Handle, Stone pendant, Engraved antler

Students will work in small groups.

Lesson Objectives
- Learn techniques to accurately map and document an archaeological site, such as using a baseline, using a grid system, triangulation, and scale drawing.
- Draw a scale map of the classroom and identify the precise location of "artifacts".
- Make inferences about artifacts based on their context.

Sunshine State Standards
SC.H.1.2.1 Record keeping
SC.H.1.3.4 Record keeping
MA.4.G.5.3 Two-dimensional representation
MA.5.G.5.3 Measurement
SC.912.N.1.1 Scientific investigation
SS.B.1.3.1 Using Map Forms

Vocabulary
Baseline
Context
Grid System
Site Plan
Triangulation

Background Information
In archaeology, **context** refers to the relationship artifacts have to one another, as well as the situation in which they were found. Context provides important clues about the artifact and what it was used for. When removing artifacts from a site, it is essential to record the exact location of the artifacts for future study.

Archaeologists will create **site plans** – detailed maps of an archaeological site. To make the site plans accurate to scale, they may set up a **baseline** – a rope, marked in regular increments, that stretches from one end of the site to the other from which other measurements may be taken. They may also use a **grid system**, by setting up a series of baselines and perhaps smaller portable grids that may be laid upon the actual site.

The technique most commonly used by archaeologists to create an accurate site plan is **triangulation**. With triangulation, measurements are taken from an unknown point to three known points. The known points may be fixed features or may be points along a baseline.

When creating the site plan on paper, the archaeologist will use a compass to draw an arc from each known point to the area of the unknown point. The intersection of the three arcs will be the location of the unknown point.

Initial Discussion
1. Review concepts of scale, grid, coordinates, and using a compass. Define site plan, baseline, and grid system.

2. Demonstrate and explain triangulation and scale drawing. Use the overhead transparencies of the blank Student Page and the Sample Diagram to demonstrate.

Lesson 3-2: Archaeological Techniques in the Classroom

3. Distribute activity sheets, rulers and compasses. Review safety with the compass points. Remind students to set the compass using the ruler, not the compass markings for accuracy.

4. Have students follow the directions on the sheet. They will draw a small star somewhere in the square, take measurements, and make an accurate scale drawing in the smaller square pinpointing the exact location of the star using the technique of triangulation (½ scale where 1cm=2cm).

Hands-On Activity

5. Divide students into groups and explain that they will be creating a scale map of the classroom and determining the precise location of artifacts placed around the room.

6. First, they will use a grid system to create a site map of the classroom, using the tiles on the floor to create the grid. They should use notepaper to sketch a preliminary site map. First they should measure and mark fixed points in the classroom, such as the room corners or fixed items on the wall (such as a clock, door or chalkboard corner).

7. Next, they should find the sets of artifacts around the room and make measurements from each artifact to at least 3 fixed points using the measuring tape. They should record their measurements on the preliminary sketch.

8. Finally, they should return to their desks and begin making a scale site map on graph paper using the compasses and rulers. Remind students they need to notate the scale of the map, as well as label the increments on the graph paper.

9. You may want to give more or less specific instructions based on the level of your students.

Relate Activity to Concept

10. After the site maps are created, ask students to discuss their findings and make inferences about the artifacts based on their context.

11. Prompt the students with some of the following questions:
    a) Based on the items found in each area, what do you think happened there?
    b) What evidence leads to you that inference?
    c) What if the arrangement of the artifacts had been different?
    d) In what ways is context important in determining the function of artifacts?

12. Summarize the class discussion.

Assessment

Collect site maps for grading.

Modifications/ Extensions

Split up the mapping. Make two copies of the artifact set to designate 6 areas around the room. Each group will map one of the artifact areas, rather than all three. Then they would draw inferences based on the site they mapped. After groups have completed their site maps, they can share their findings and ideas from each site.

Use a baseline instead of the grid system using the tiles. Create a baseline or baselines using one or more measuring tapes affixed on the floor of the classroom. The three known points will be 3 points on the baseline, at least 1 meter apart. Use the handout "Triangulation to a Baseline" to explain this technique.

Adapted from:
- "Location, Location, Location: Using a Grid to Determine Context" by Tony Castro. Texas Beyond History. Univ. of Texas at Austin. 2006. www.texasbeyondhistory.net/teach/lessons.html

Scale Drawing and Triangulation

Name: _____

Draw a small star on the 10 cm x 10 cm square below. Then draw lines between the center of the star and 3 corners of the square (3 known points). Label and measure each line and record your measurements at right.

1 **2**

3

Corner 1: _____

Corner 2: _____

Corner 3: _____

Create a scale drawing of the square above at ½ scale, using the 5 cm x 5 cm square below. First calculate the new measurements (dividing by two). Then set the compass to the first measurement. Use the compass to draw an arc from the corner in the center of the square. Do the same with the next two measurements. If done correctly, the arcs should come together at one point. That will be the location of the star!

1 **2**

3

Corner 1: _____

Corner 2: _____

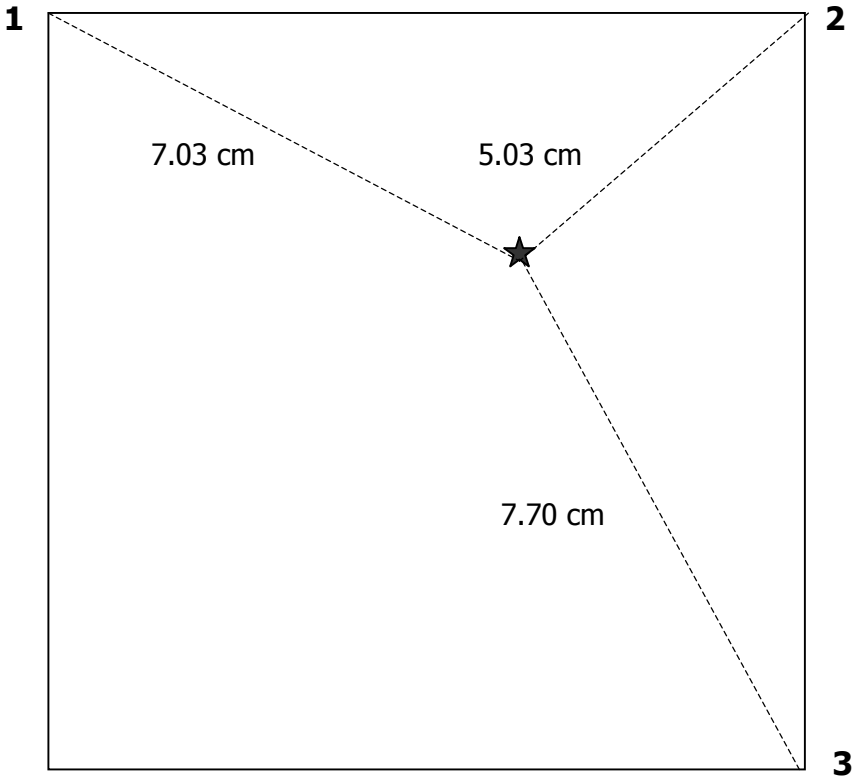
Corner 3: _____

How did you do? How close were the arcs?

Scale Drawing and Triangulation

Name: Sample Diagram

Draw a small star on the 10 cm x 10 cm square below. Then draw lines between the center of the star and 3 corners of the square (3 known points). Label and measure each line and record your measurements at right.

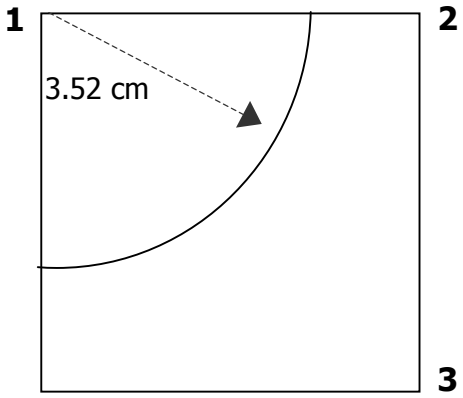


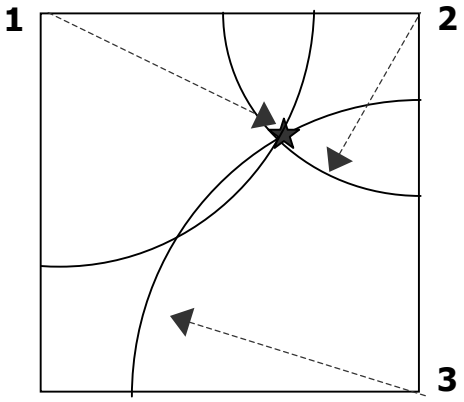
Corner 1: 7.03 cm

Corner 2: 5.03 cm

Corner 3: 7.70 cm

Create a scale drawing of the square above at ½ scale, using the 5 cm x 5 cm square below. First calculate the new measurements (dividing by two). Then set the compass to the first measurement. Use the compass to draw an arc from the corner in the center of the square. Do the same with the next two measurements. If done correctly, the arcs should come together at one point. That will be the location of the star!





Corner 1: 3.52 cm

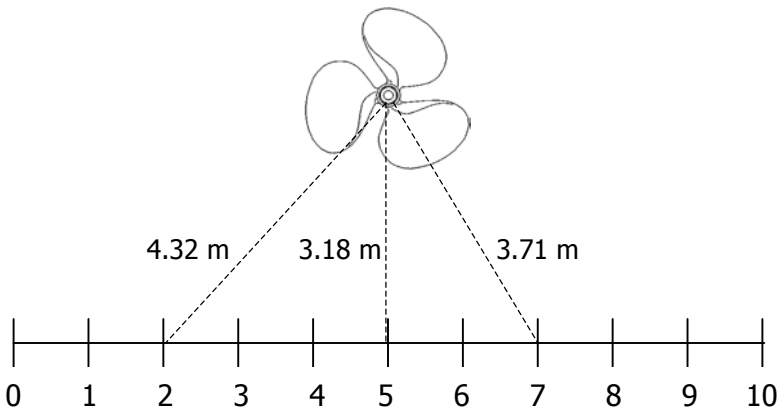
Corner 2: 2.52 cm

Corner 3: 3.85 cm

How did you do? How close were the arcs?

Triangulation to a Baseline

The triangulation technique can also be used with a baseline.
Select 3 points on the baseline and measure between the object and each selected point.

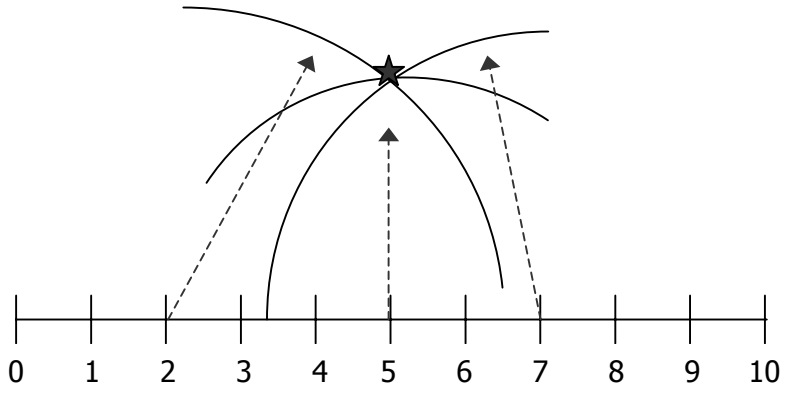


Meter 2: 4.32 m

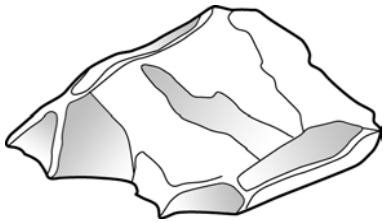
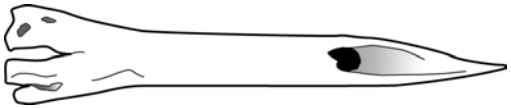
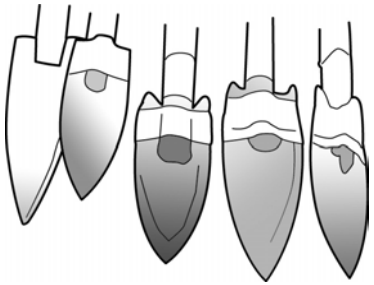
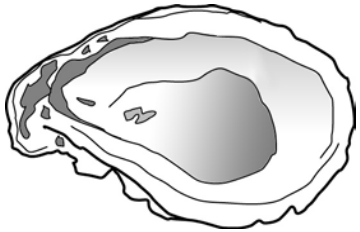
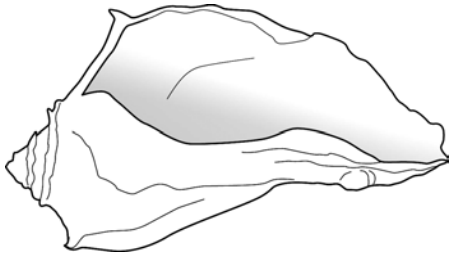
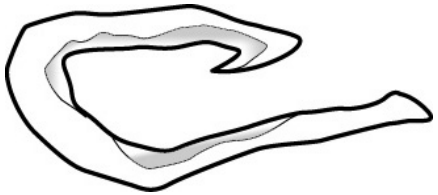
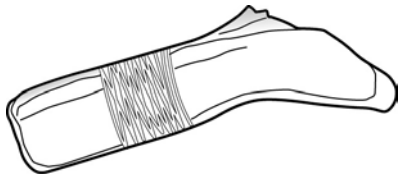
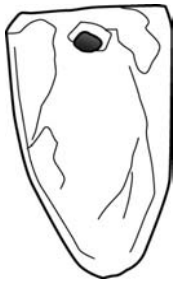
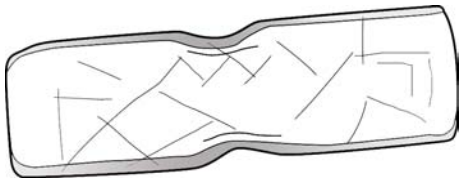
Meter 5: 3.18 m

Meter 7: 3.71 m

On the site map, first draw the baseline to scale. Then set the compass to the first measurement. Use the compass to draw an arc from the point on the baseline to the center of the map. Do the same with the next two measurements. If done correctly, the arcs should come together at one point. That will be the location of the object.



Artifacts Around the Room

Stone scraper 	**Deer bone tool** 	**Spear points** 
Oyster shells 	**Shell dipper** 	**Shell fishhook** 
Decorated Deer Handle 	**Stone pendant** 	**Engraved antler tool** 

Lesson 3-3: Model Shipwreck

Time Allotment
60-120 minutes, divided between several class periods if necessary

Materials
(see Teacher Directions for modifications)
- 2-D Shipwreck Outline
- "Artifacts" (objects or photos)
- Two measuring tapes
- Masking tape

Per group:
- Measuring tape and/or meter stick
- Clipboard
- Blank Paper

Per student:
- Graph paper
- Compass
- Ruler
- Pencil
- Shipwreck Report Summary

Advance Preparation
Create the model shipwreck and set it up in an empty classroom. See Teacher Directions.

Make copies of the activity sheet.

Students will work in small groups of 3 to 4.

Lesson Objectives
- Explore, map and document artifacts in a hypothetical underwater archaeological site.
- Work in teams to collect data, practicing archaeological techniques, including scale drawing, using a baseline, and triangulation.
- Write a story about the shipwreck based on the data found.

Sunshine State Standards
SC.H.1.2.1 Record keeping
SC.H.1.2.2 Observation and analysis
SC.H.1.2.3 Working collaboratively
SC.H.1.2.5 Models
SC.H.1.3.4 Record keeping
SC.H.3.2.4 Problem solving
MA.4.G.5.3 Two-dimensional representation
MA.5.G.5.3 Measurement
SS.B.1.3.1 Using Map Forms

Vocabulary
Baseline	Site Plan
Dive Plan	Triangulation

Background Information
In order to maximize the benefits of excavation, archaeological research must be well planned and carefully documented. Since time and communication are limited in underwater sites, it is even more essential that the expedition be well planned. Underwater communication is difficult but the technology has really improved in the last 10 years. Wireless voice-activated microphones require a full-face mask, but work well in low-visibility sites.

Often archaeologists will start with exploratory dives to assess the site and gather enough information to create a detailed **dive plan**. The dive plan will include specific instructions for data collection, as well as logistical and safety considerations. Data is usually collected over the course of several dives.

Initial Discussion
1. Review how underwater archaeology is different from archaeology above ground. Discuss limitations on time and communication. Underwater archaeologists need to carefully plan their dives, so that they make the most of their limited time. They also need to make sure everyone on the team understands the plan and is ready to do their part correctly.

2. Review the archaeological techniques: baseline, scale drawing, triangulation. Emphasize the importance of these techniques in accurate data collection.

Hands-On Activity
3. Explain that the students will work in teams to document a model shipwreck.

4. There are 5 steps to this project:
   a) **Preview the site.** Each team will get a chance to preview the site. They may walk silently around the site, then return

to the classroom. In this preliminary dive, they are not allowed to speak until they return to the classroom. You may choose to have the whole class visit the site at once, or in small groups.

b) **Create a dive plan.** Students need to create a very specific dive plan for their team. What are they going to do? In what order will measurements be taken?

Determine specific roles for the team:
1. Recorder
2. "Zero" end of the measuring tape
3. "Measure" end of the tape
4. Site planner, who makes sure the dive plan is being followed.

If there are only 3 in a group, then someone can double up as site planner.

Students should agree on signals for the dive. For example, two common signals are: one pull of the tape means move onto the next measurement, and two pulls of the tape means come to the measuring end for discussion.

Remind students that when taking measurements, they should measure from a specific point on the artifact to 3 points on the baseline.

c) **Dive the site.** Students will "dive" the site and collect data, including ship dimensions and the location of artifacts. Sketch the wreck and record measurements on the sketch paper.

Remind students that they may not speak during the dive. They may use signals and write notes on clipboards.

Give teams a time limit for the dive. If they do not collect all the data they need, they may share data with other groups back in the classroom, if you choose. (See modifications.)

d) **Create a site plan.** Back in the classroom, each student will create a scaled site plan of the wreck on graph paper, using data collected by the group. They must include a scale for the map.

e) **Write the Shipwreck Report.** Use the Shipwreck Report sheet as a guideline to summarize findings from the wreck. Discuss the group findings and record inferences about what the ship may have been used for.

Relate Activity to Concept

5. Individually, students will write a story about the ship, based on artifacts found. They may use shared ideas, but the stories must be original. You may choose to have students write the story from the perspective of a crewmember or passenger on the ship.

6. Have students share their stories in small groups or with the whole class. Share the story you had in mind when creating the wreck. How do the stories compare? How do archaeologists determine what was the "correct" story?

Assessment

Collect site maps, Shipwreck Reports, and stories for grading.

Modifications/ Extensions

If time is limited, have student record data from one section of the shipwreck – OR – have students triangulate measurements for one object per section, then sketch the rest.

See Teacher Directions for additional modifications.

Adapted from:
- "Mock Shipwreck: An Exercise in Maritime Archaeology" by Kate Thompson. NOAA's National Marine Sanctuary Program. http://sanctuaries.noaa.gov/education

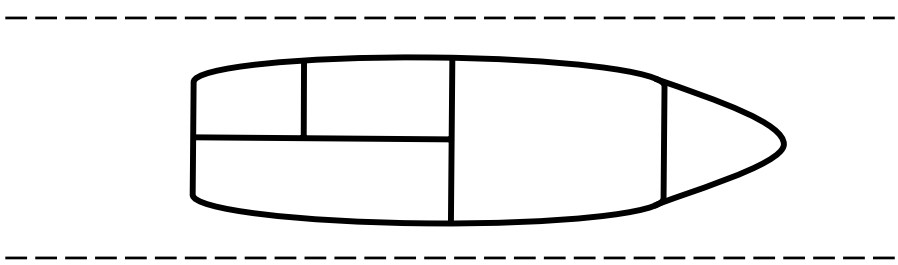
Lesson 3-3: Model Shipwreck

Teacher Directions

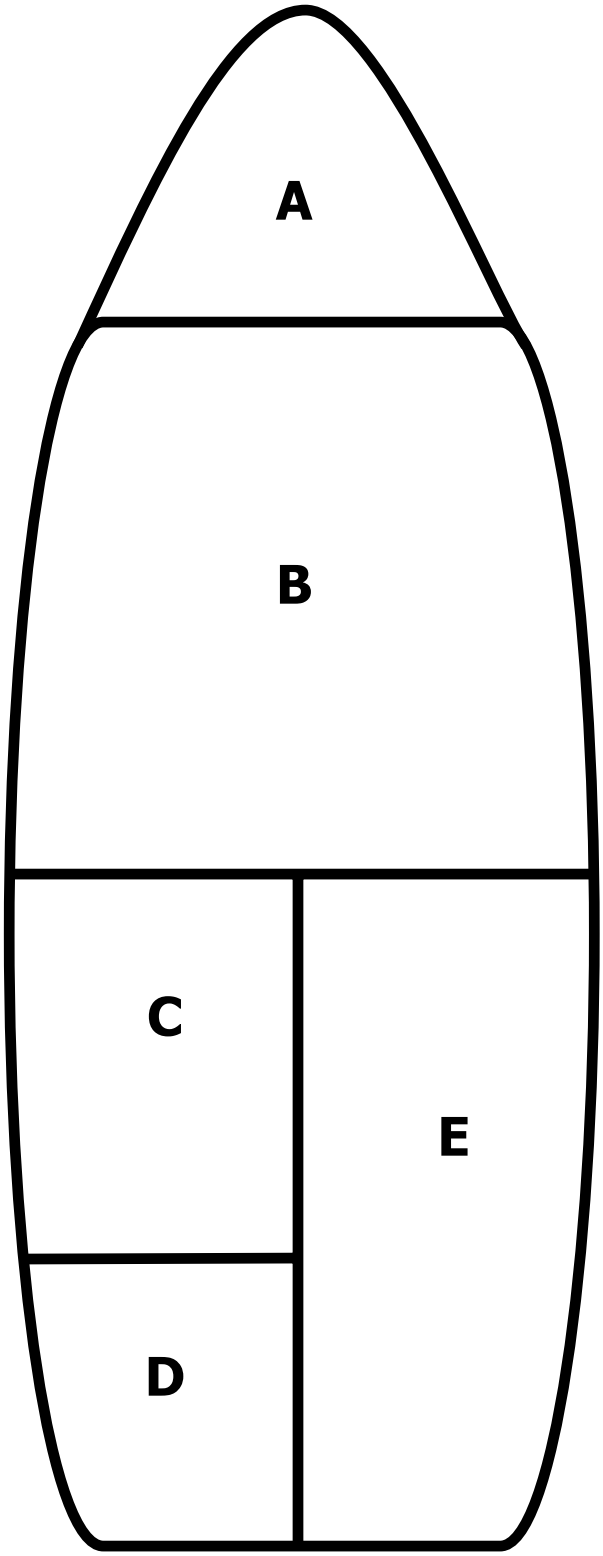
1. **Create the shipwreck outline.**
   a) Use the 2-D Shipwreck Outline provided to make an outline of large paper (butcher paper or poster paper).
      i) Use a poster maker to print out the outline.
      ii) Copy or draw the sample outline onto a transparency and project it on to butcher paper hung on the wall. Then trace the outline using a thick felt-tip marker.
      iii) Draw the outline onto paper freehand using a thick felt-tip marker.

   Modification: Make 1 to 3 large outlines (8-12 ft long) –OR– Make 5 to 10 smaller outlines (4-6 ft). Divide the groups among the wrecks accordingly.

2. **Place the shipwreck outline(s) on the floor in an empty classroom, gym, etc. Place two measuring tapes on either side of the wreck as baselines.** Use masking tape to secure the outline and baselines to the floor. Groups must choose one baseline to work from so that there is not as much crowding.



3. **Place artifacts on the wreck. Use classroom objects, objects from home and/or illustrations and photographs.**
   a) The number of artifacts you add depends on the time your students will have to document the wreck. Whether each group is documenting the entire wreck or just a section of the wreck, you may want to limit the number of artifacts to 5 to 8 per group.
   b) Consider the placement of similar objects together to help students draw conclusions. For example, bowls and silverware in one area may be a cooking area and books and clipboards may be a research area.
   c) Depending on what type of wreck you'd like to create and what type of discussion you would like your class to have, feel free to modify the artifacts in the wreck. Ideas for artifacts include:
      i) Pots, pans, silverware, mugs, etc.
      ii) Binoculars, maps, compass, etc.
      iii) Books, pens, clipboards, etc.
      iv) Shoes, toothbrush, watch, etc.


A
B
C
E
D

Shipwreck Report Summary

Date: _____ Time: _____

Site Name: _____

Dive Team Names: _____

_____

Site Description/ Notes:

Artifact Description	Baseline Point #1	Distance to #1	Baseline Point #2	Distance to #2	Baseline Point #3	Distance to #3
Example: Propeller	*2 m*	*4.32 m*	*5 m*	*3.18 m*	*7 m*	*3.71 m*

Shipwreck Report Summary

Dive plan:
List of team members and their primary tasks during the dive

Site Description:
What measurements were taken?

How were the measurements taken?

What were some general observations of the site?

Ship Observations & Measurements:
What were the dimensions of the ship and its compartments?

What types of artifacts did you find?

What were the compartments/ rooms used for?

What do you think the ship was used for?

Site assessment:
What worked well?

What difficulties did your group find?

What would you do next?

Lesson 4-1: Archaeological Dilemmas

Time Allotment
Introduction: 10 minutes
Debate Preparation: varies
Debates: 15 –20 minutes each

Materials
Per student:
- Archaeology Dilemmas sheet

Advance Preparation
Make copies of the activity sheet.

Students will work in teams of 2 to 5.

Lesson Objectives
- Debate a given ethical dilemma about archaeology.
- Develop arguments to support a viewpoint.
- Write personal statements about ethical dilemmas debated in class.

Sunshine State Standards
SC.H.3.3.1 Ethical concerns
SC.H.3.3.6 Knowledge available universally
LA.7.5.2.1 Listening strategies
LA.7.5.2.2 Analyze persuasive speech
LA.7.5.2.3 Organize and give persuasive speech

Initial Discussion
1. Tell students you will present them with several statements about archaeology. Think about your point of view and how much you agree or disagree with the statement. Rank your opinion on a scale of 1 to 10, with 1 meaning total disagreement and 10 meaning total agreement.

2. Present an imaginary line along the classroom, with one end representing a scale of 1 to 10. For each statement, the students must position themselves somewhere on the line, based on their level of agreement with the statement.

3. Depending on your class, you may want to select students at different points along the scale to share their reasoning for their position.

4. Begin with 2 sample statements (as suggested below), and then move onto the Archaeology Dilemma statements.

   a) Chocolate is the best dessert.

   b) Scuba diving would make me nervous.

   c) Archaeologists have no right to dig up gravesites of other peoples' ancestors.

   d) People who find artifacts should sell it online to the highest bidder.

   e) Telling the public about underwater archaeology sites is irresponsible, because it could put untrained divers in dangerous situations.

   f) It is more important to bring underwater artifacts to the surface than to leave it in its original site.

Hands-On Activity
5. Hand out the Dilemma Question sheets. On each of the "Initial Opinion" scales, have student record their initial responses for each question. These archaeology dilemma statements will be the basis of the debates.

6. Describe the debate format.

   a) The teacher will be the moderator.

   b) The class will divide into 8 groups to debate 4 topics (one side for, one side against each topic).

   c) Each group must develop 3 to 5 main arguments for their side.

   d) Each team member must present at least one argument in both the opening and closing statements.

   e) Each person in the team is responsible for presenting at least 1 argument during the rebuttal –or– answering 1 question by the moderator.

7. Class Participation Options:
   a) If you have a small class, have the students who are not debating stand on the imaginary line and periodically change positions if their opinion is changed by the debate.

   b) You may have one student in each team present the opening statement, one present the rebuttal and one present the closing statement.

Relate Activity to Concept

8. At the end of each debate, have students revisit the Dilemma Question sheets. Indicate their new position on the scale. Then write their reasoning for choosing the same or a different position.

Assessment

Collect activity sheets for grading.

Modifications/ Extensions

Develop debate topics. Have students develop their own debate topics, or develop topics based on discussion during the underwater archaeology activities.

Practice the debates. Have students practice debating within their team groups, if time allows.

Archaeology Dilemmas

Consider your opinion on the following statements. Rank your opinion on a scale of 1 to 10, with 1 meaning total disagreement and 10 meaning total agreement.

#1: Archaeologists have no right to dig up gravesites of other peoples' ancestors.

Initial Opinion:

1 2 3 4 5 6 7 8 9 10

Opinion after the debate:

1 2 3 4 5 6 7 8 9 10

Did you change your opinion after the debate? Briefly describe how and why.

#2: People who find artifacts should sell it online to the highest bidder.

Initial Opinion:

1 2 3 4 5 6 7 8 9 10

Opinion after the debate:

1 2 3 4 5 6 7 8 9 10

Did you change your opinion after the debate? Briefly describe how and why.

Archaeology Dilemmas

#3: Telling the public about underwater archaeology sites is irresponsible, because it could put untrained divers in dangerous situations.

Initial Opinion:

1 2 3 4 5 6 7 8 9 10

Opinion after the debate:

1 2 3 4 5 6 7 8 9 10

Did you change your opinion after the debate? Briefly describe how and why.

#4: It is more important to bring underwater artifacts to the surface than to leave it in its original site.

Initial Opinion:

1 2 3 4 5 6 7 8 9 10

Opinion after the debate:

1 2 3 4 5 6 7 8 9 10

Did you change your opinion after the debate? Briefly describe how and why.

Archaeology Dilemmas Debate Rubric

Name: _____

	4	3	2	1 or 0
Opening Statement	Well-thought out, organized presentation of the arguments and evidence. Opening statement clearly identifies at least 3 main issues and interests the audience.	Organized, generally complete presentation of arguments and evidence. Opening statement identifies 3 main issues and somewhat interests the audience.	Somewhat organized presentation of arguments and evidence. Opening statement outlines 2 main issues and somewhat interests the audience.	Unorganized or incomplete presentation of arguments and evidence. Opening statement states at least 1 main issue, but is not interesting to the audience.
Closing Statement	Thorough, well-organized presentation of the arguments and evidence. Closing statement summarizes all arguments made in the debate.	Organized, generally complete presentation of arguments and evidence. Closing statement summarizes many arguments made in the debate.	Somewhat organized presentation of arguments and evidence. Closing statement briefly restates arguments made in the debate.	Unorganized or incomplete presentation of arguments and evidence. Closing statement briefly mentions the general position of the team.
Rebuttals	Responds to issues raised by opponents with concise, accurate and logical answers. Challenges arguments made by opponents with specific examples.	Responds to most issues raised by opponents with accurate answers. Challenges arguments made by opponents with general examples.	Responds to some issues raised by opponents with generally accurate answers. Attempts to challenge arguments made by opponents.	Is unable to respond to issues raised by opponents accurately or logically.
Use of Persuasion	Uses logical, emotional and ethical appeals to enhance the effectiveness of the arguments.	Uses logical, emotional and ethical appeals to enhance the arguments.	Uses some logical and emotional appeals to persuade.	Does not use persuasive techniques.
Participation	All team members participated equally in statements and rebuttals. Responded to audience questions with specific answers.	All team members participated in statements and rebuttals. Responded to audience questions with general answers.	Some team members did not participate in the statements or rebuttals. Responded to audience questions with vague answers.	Some team members did not participate in the debate, or team did not answer audience questions.
Performance & Respect	Exhibits confidence and energy in the debate, speaking clearly and loud enough. Respect was shown throughout the debate for the opposing team (no name calling, interrupting, etc.)	Appears nervous, yet somewhat confident during the debate, speaking clearly and loud enough. Respect was shown throughout the debate for the opposing team (no name calling, interrupting, etc.)	Lacks confidence during the debate, or did not speak clearly and loud enough. Respect was shown throughout the debate for the opposing team.	Appears nervous and unprepared during the debate, and did not speak clearly or loud enough. Did not show respect for the opposing team.

Archaeology Resources

Internet Resources

www.flpublicarchaeology.org/wcrc/links.htm
Florida Public Archaeology Network; Links to many teaching resources

dhr.dos.state.fl.us/archaeology/underwater/
State of Florida government site; Picture galleries and underwater arch preserves

www.marinearcheology.org/
Marine Archaeological Research and Conservation Inc.; Videos and info on Florida shipwrecks

www.flmnh.ufl.edu/natsci/vertpaleo/aucilla/arpp01.htm
Florida Museum of Natural History; Aucilla River Prehistory Project slideshow

www.nps.gov/history/nr/travel/flshipwrecks/index.htm
National Park Service; Descriptions of Florida shipwrecks

www.nps.gov/bisc/historyculture/maritime_heritage_trail.htm
National Park Service; 5 shipwrecks in Biscayne Bay

sanctuaries.noaa.gov/education/teachers/curriculum.html
National Marines Sanctuary; Lesson plans and activities

www.archaeological.org/webinfo.php?page=10329
Archaeological Institute of America; Detailed lesson plans for shoebox and simulated digs

www.saa.org/public/resources/saalessons.html
Society for American Archaeology ;Lesson Plans (same site as above under "Resources")

www.saa.org/pubEdu/sampler/TOC.html
Society for American Archaeology; Teaching Archaeology

www.nationalgeographic.com/xpeditions/lessons/17/g912/methods.html
National Geographic Lessons

crt.louisiana.gov/archaeology/HOMEPAGE/activity_booklets.shtml
Louisiana Division of Archaeology; Poverty Point Expeditions curriculum

perth.uwlax.edu/mvac/Educators/LessonPlans.htm
Mississippi Valley Archaeology Center- Activities, Lesson Plans, Power Point Presentations

www.nps.gov/goga/forteachers/upload/Questioning_Artifacts_curriculum.pdf
National Park Service, Alcatraz Island-Golden Gate Park; Archaeology lessons

www.learnnc.org/lp/editions/intrigue/2.0
University of North Carolina- Chapel Hill School of Education. Intrigue of the Past Archaeology Curriculum

www.texasbeyondhistory.net/teach/lessons.html
Texas Beyond History. Univ. of Texas at Austin; Lessons about Paleoindians and Archaic people

Archaeology Resources

VIDEOS:

www.rsmas.miami.edu/groups/lss/videos.html
University of Miami; Little Salt Spring videos

www.studio10.tv/category/education/segment.aspx/85322/Little_Salt_Spring
6 min video about 2008 Nat'l Geog expedition

www.tampabays10.com/video/news/default.aspx?sid=80796&aid=62011
Video on Hillsborough River Confederate ship find

www.myfoxtampabay.com/myfox/pages/Home/Detail?contentId=6989034&version=2&locale=EN-US&layoutCode=TSTY&pageId=1.1.1
Video on Little Salt Spring 2008

www2.tbo.com/static/photo_gallery/tbo-special-reports-news-photo-gallery-salt-spring/
Audio Slide Show about Little Salt Spring 2008

www.unesco.org/culture/en/underwater/film/
United Nations; 12 minute Underwater cultural heritage video

Glossary of Terms

Archaeology – the study of human past through its material remains (artifacts).

Archaic – people who lived in North America between 5,000 and 7,500 years ago, after the end of the last Ice Age. Archaic culture showed a noticeable change in culture, tool technology, and settlement patterns from Paleoindians.

Artifact – any tool, implement, or object manufactured or modified by humans.

Baseline – a rope, marked in regular increments, that stretches from one end of the site to the other from which other measurements may be taken.

Climate – the average weather conditions in an area over a period of years, including average temperature, wind speeds, and precipitation.

Context – the relationship artifacts have to one another, as well as the situation in which they were found. Context provides important clues about the artifact and what it was used for.

Culture – a shared set of beliefs and behaviors that helps mold one's responses to different situations.

Decomposition – the process of breaking down organic matter by organisms (decomposers).

Dive Plan – a plan for an underwater archaeology exploration that includes specific instructions for data collection, as well as logistical and safety considerations.

Environment – the sum of conditions affecting an organism, including all living and nonliving things in an area, such as plants, animals, water, soil, weather, landforms, and air.

Experiment – a procedure that is carried out and repeated under controlled conditions in order to discover, demonstrate, or test a hypothesis; includes all components of the scientific method.

Global Positioning System – technology used to track specific locations using signals from a satellite.

Grid System – a system for mapping archaeological sites whereby a series of baselines are set up at right angles over the site, or smaller portable grids are laid upon the actual site.

Hydrography – the science of measuring and describing the physical features of bodies of water, including underwater terrain, depths of coastal waters, and the shape of coastlines.

Ice Age – an interval of time when large areas of the surface of the earth are covered with ice sheets (large continental glaciers). Ice Age often refers to the most recent glacial period the started about 70,000 years ago and ended about 10,000 years ago.

Inference – a conclusion derived from observations, base on our past experiences and knowledge.

Lead lines – ropes marked at regular intervals with a 10-lb lead weight tied to the end used to measure water depth.

Observation – the act of recognizing and noting a fact or occurrence, often involving objective measurement.

Paleoindian – Native Americans who lived between 9,000 and 12,000 years ago, during the Ice Age.

Site Plan – detailed maps of an archaeological site.

Glossary of Terms

Sonar – technology that transmits sound pulses through the water; the sound waves reflect off the bottom of the seafloor and are detected by a receiver. The strength of the returning echo is recorded and analyzed by a computer to create a "picture" of the seafloor.

Soundings – measurements of water depth using a lead line.

Terrestrial archaeology – archaeology on land, as opposed to underwater archaeology.

Topography – the surface, shape, and composition of a land area.

Triangulation – a technique for measuring precise distances for a site plan. Measurements are taken from an unknown point to three known points. Using a compass, an arc is drawn from each known point to the area of the unknown point. The intersection of the three arcs will be the exact location of the unknown point.

Variable – an event, condition, or factor that can be changed or controlled in order to study or test a hypothesis in a scientific experiment.