

Thunder Bay 2010:
Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships

Ancient Hunters of the Great Lakes

(adapted from the Exploring the Submerged New World 2009 Expedition)



Focus

Early humans in the Great Lakes region

Grade Level

9-12 (Anthropology/Earth Science)

Focus Question

When did the first humans arrive in the Great Lakes region, where did they come from, and how did they get here?

Learning Objectives

- Students will describe alternative theories for how the first humans came to the Americas and explain the evidence that supports or contradicts these theories.
- Students will explain how exploration of a submerged portion of the Lake Huron coastline may provide additional insights about early human inhabitants of the Great Lakes region.
- Students will describe the role of skepticism in scientific inquiry.



Materials

- Copies of History of Ice Age Americans Inquiry Guide, one copy for each student or student group

Audio-Visual Materials

- None

Teaching Time

One or two 45-minute class periods

Seating Arrangement

Groups of 2-4 students

Maximum Number of Students

32

Key Words

Lake Huron
Marine archaeology
Monte Verde
Beringia
Daisy Cave
Ice-free corridor

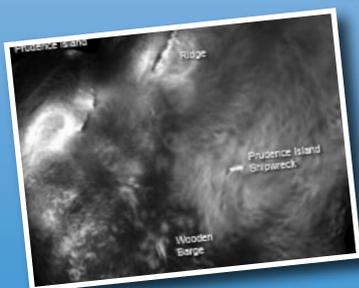


Image captions/credits on Page 2.

lesson plan

Meadowcroft Rock Shelter
Kennewick Man
Clovis First
Clovis points

Background Information

NOTE: Explanations and procedures in this lesson are written at a level appropriate to professional educators. In presenting and discussing this material with students, educators may need to adapt the language and instructional approach to styles that are best suited to specific student groups.

“Man hoisted sail before he saddled a horse. He poled and paddled along rivers and navigated the open seas before he traveled on wheel along a road. Watercraft were the first of all vehicles.”

Thor Heyerdahl, Early Man and the Ocean (Doubleday, 1979)

Lake Huron covers 23,010 square miles (59,596 square kilometers) on the border between Canada and the United States, and has been a significant focus of human activity for thousands of years. If the shorelines of its 30,000 islands are included, Lake Huron has the longest shoreline of the Great Lakes and is the second largest by surface area. The lake is also notorious for its dense fog banks, violent storms, and rocky shoreline—hazards that have brought disaster to many ships.

It is not certain when the first boats appeared on Lake Huron. Southern Michigan was probably occupied near the end of the last ice age (about 12,000 years ago), but northern Michigan probably was not occupied until several thousand years later. People in other parts of the world used boats since Neolithic times (the ‘Stone Age’; 8,500 – 5,200 years ago; see http://oceanexplorer.noaa.gov/explorations/06greece/background/edu/media/old_ship.pdf for more information), and there is good evidence that boats may have been used when early inhabitants of North and South America migrated from Siberia about 13,000 years ago (see below). Archaic people in Michigan began to utilize fish sometime around 5,000 years ago, as indicated by artifacts such as bone or copper fishhooks, spears, notched pebble net-sinkers, and fish bones (especially sturgeon) found in upper Great Lakes sites; but humans may have been in the region much earlier.

Physical remains of ancient cultures can provide information about trading patterns, sociopolitical networks, technological development and many other unique insights; but a variety of factors make it difficult to find such remnants. One factor in many coastal regions is that water levels have changed significantly since humans first arrived in North America. The level of Lake Huron, for example, has varied from 55 - 80 m above mean sea level about 9,900 - 7,500 years ago to its present level of 176 m above mean sea level. This means that artifacts

Images from Page 1 top to bottom:

Existing (yellow) and proposed (green) boundaries of the Thunder Bay National Marine Sanctuary. Locations of some known shipwrecks are indicated. Source: Thunder Bay National Marine Sanctuary

A crew in a support boat releases the line from the Naval Undersea Warfare Center (NUWC) REMUS 600 unmanned underwater vehicle equipped with the Integrated Precision Underwater Mapping (iPUMA) subsystem in Narragansett Bay during the Autonomous Vehicle Fest in May 2008.

<http://www.militaryaerospace.com/index/display/article-display/337291/articles/military-aerospace-electronics/volume-19/issue-8/features/special-report/swimming-robots.html>

This image was captured by iPUMA, a wide-swath forward-looking sonar used to identify possible targets. Here we see the two wrecks off Prudence Island, as well as features on the surrounding seafloor. To get a sense of scale, consider that the wooden barge is 120 feet long.

http://oceanexplorer.noaa.gov/explorations/08aufvest/logs/summary/media/ipuma_s2_3_sonar.html

Once a shipwreck has been located on a sonar image, archaeologists don SCUBA gear to “ground truth” the discovery. Dives deeper than about 40 m require the use of special breathing mixtures containing helium, oxygen, and nitrogen to reduce some of the safety hazards that accompany breathing ordinary air during deep dives. Source: Thunder Bay National Marine Sanctuary

Map 1. Great Lakes region, with Thunder Bay National Marine Sanctuary marked with a red dot.



US Army Corps of Engineers, Detroit District. From Wikipedia.

Figure 1. Existing (yellow) and proposed (green) boundaries of the Thunder Bay National Marine Sanctuary. Locations of some known shipwrecks are indicated. Source: Thunder Bay National Marine Sanctuary



from early human activity around Lake Huron may now be more than 120 m below the lake's surface! Recently, archaeologists have discovered evidence of prehistoric hunters on a submerged ridge (20 - 40 m deep) that was above the surface of Lake Huron 9,900 - 7,500 years ago (O'Shea and Meadows, 2009).

The origin of the first people to inhabit North and South America has been a subject of controversy for decades. In 1927, archaeologists working near Folsom, New Mexico discovered a stone spear point embedded in the rib cage of an extinct bison. This discovery provided direct proof that humans and large extinct mammals co-existed for a time, and that humans had arrived in North America by the end of the Pleistocene epoch (about 11,000 years ago). Several years later, distinctive long spear points were discovered at an archeological site near Clovis, New Mexico, along with bones of prey dated to as far back as 11,200 years ago.

During the years following discovery of sites at Folsom and Clovis, a theory developed that became widely accepted as fact, even though there was very little supporting evidence. This theory proposed that the first humans to enter North America were a small group of hunters that migrated from Asia by walking across a land bridge between Asia and North America about 13,500 years ago, passing through an inland ice-free corridor in western Canada. These pioneers, called "Clovis people," carried thrusting spears tipped with specialized stone points that made them very successful hunters of the large mammals that inhabited North America. Their success allowed the first group to rapidly expand throughout North and South America, and after approximately 1,000 years the Clovis people are supposed to have exterminated 33 genera in North America and more than 50 genera in South America. The key element of this theory is that the "Clovis people" were the first human inhabitants of North and South America; hence this theory has come to be known as the Clovis First model.

There were several problems with the Clovis First model. One problem is that the distinctive stone spear points that are a key part of the model have not been found in Siberia which is supposed to have been the point of departure for the pioneers. A related problem is that the stone points found in the United States appear to be older than points found in the far north. In addition, other stone projectile points, shaped differently than the Clovis points, have been found at sites in the United States that are just as old as the Clovis specimens. Possibly the most serious problem was the discovery of sites in North and South America that are much older than the Clovis sites.

There are also difficulties concerning the proposed timing of the "Clovis migration." When humans arrived in the Siberian Arctic about 32,000 years ago, there were ice-free corridors along the Pacific coast and

2. Briefly introduce students to “Shipwreck Alley” and the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron’s Lost Ships Expedition. Ask students when they think boats and ships were first used in human history and in North America, and what kinds of evidence might help answer this question. The best evidence would be physical remains ancient boats, which could be dated by examining radioactive isotopes in the remains. Unfortunately, many of the materials that were available to ancient people deteriorate rather rapidly. Indirect evidence, such as the presence of ancient human artifacts on islands that could only have been reached by boat, is an alternative possibility. Describe recent evidence for ancient hunters in the Great Lakes region, and ask students whether these early inhabitants might have used boats of some kind.

Ask students when they think humans first came to North America, where they came from, and how they arrived. Explain the background to the Clovis First theory and the theory’s major features. List some of the problems with the theory. Lead a discussion of how scientific theories evolve and change. In general, skepticism of change is an important part of science, and new theories have to be supported by substantial evidence. On the other hand, it is also important for new evidence to receive a fair hearing. The history of science contains many examples of visionaries whose ideas were considered ridiculous for many years before they were finally accepted as correct.

3. Distribute the *History of Ice Age Americans Inquiry Guide*. Divide the questions evenly among students or student groups. Have students prepare oral or written reports on the questions they are assigned to research. Emphasize that there may be more than one answer for some questions, and that the “correct” answers may not be known; the important thing is to have a reasonable answer that is consistent with available evidence.

4. Have students present results of their inquiries in a seminar format. Encourage discussion of various pieces of evidence, as well as speculation on possible explanations that have not been investigated. When all results have been presented, have each student write a brief summary describing what they believe to be the most probable explanations of when, how, and from where the first Americans arrived in North America. The following points should be included in the discussion:

- 1) Monte Verde, an archaeological site in Chile, is widely acknowledged to have been inhabited between 12,500 and 14,600 years ago, and has a large number of artifacts that are exceptionally well-preserved. This evidence conflicts with the Clovis First theory.

- 2) Beringia is a region that includes present-day Alaska, the Yukon Territory, northeast Siberia, and the now-submerged Bering Sea platform. It is believed that during the last Ice Age, the Bering Sea platform formed a land bridge that connected Asia and North America.
- 3) The Meadowcroft Rock Shelter site in Pennsylvania contains artifacts that may be 18,000 - 22,000 years old. The Page-Ladson site in Florida contains tools and a mastodon tusk that are estimated to be about 14,400 years old. At Paisley Cave, in Oregon, three human coprolites (fossilized fecal material) were found with an estimated age of about 14,100 years. All of these observations are inconsistent with the Clovis First theory.
- 4) The Ice Free Corridor hypothesis is part of the Clovis First theory. This hypothesis suggests that the first humans to enter North America arrived from Siberia after crossing a land bridge, then migrated through an inland passage between the Laurentide and Cordilleran ice masses. These ice masses blocked all inland routes from 24,000 years ago until 14,000 - 13,500 years ago.
- 5) Dr. Carol Mandryk is a paleoecologist at Harvard University who has investigated prehistoric vegetation in Alberta, which would have been at the southern end of the "ice-free corridor." She has found that there was not enough biomass to support humans until after 13,000 years ago, and that the corridor was not open until 11,500 years ago. In addition, her research shows that even after the ice sheets began to open a path, there was not enough vegetation there to support the large animals that migrating people would have had to depend on for food.
- 6) While inland routes were blocked by ice until at least 14,000 years ago, coastal routes were open to migration at least 15,000 years ago. So, the first Americans could have arrived by boat.
- 7) Arlington Springs is on Santa Rosa Island in the northern Channel Islands off the southern coast of California. Human remains have been found at Arlington Springs that are estimated to be 13,000 - 13,100 year old. Santa Rosa Island was an island even during the Ice Ages, so it could only have been reached by boat. These observations support the idea that some of the first Americans may have traveled by sea, which is an alternative to the land migration proposed in the Clovis First theory.
- 8) Australia has been isolated by water since at least 60 million years ago. There is evidence that humans have been present in Australia for at least 40,000 years, and no explanation has been proposed for how they could have arrived other than by boat.

This suggests that boats may also have been available to the first humans to enter the Americas; again, suggesting water travel as an alternative to the land migration proposed in the Clovis First theory.

9) DNA studies suggest that the first Americans came from a single population in Siberia, and migrated from Beringia sometime after 16,500 years ago.

10) Students should realize that the scientific method is based on testing hypotheses. To help resolve debates about theories such as Clovis First, scientists need to make predictions based on the theory, and then test whether these predictions are true. In the case of Clovis First, one prediction might be, "There is no evidence of human occupation in North America before 11,500 years ago." If no evidence was found after investigating many sites, this would support the theory. But the theory would not be proven, because a single site older than 11,500 would demonstrate that the theory is incorrect. But if supporters of the theory deliberately block funding for research on sites that might be older, then the theory cannot be disproven—even though such sites might exist. With this kind of constraint, key predictions cannot be tested, so the scientific method cannot be applied.

The BRIDGE Connection

www.vims.edu/bridge/archive1200.html/ – Links to resources about shipwrecks and marine archaeology.

The "Me" Connection

Have students write an essay on why the question of the origin of the first Americans is or is not worthy of publicly supported research.

Connections to Other Subjects

English/Language Arts, Geography, Earth Science

Assessment

Students' research reports and class discussions provide opportunities for assessment.

Extensions

1. Have students visit <http://oceanexplorer.noaa.gov/10thunderbay/welcome.html> to keep up with the latest discoveries from the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships Expedition.
2. Visit <http://www.pbs.org/wgbh/nova/first/> for information and resources about the discovery and controversy surrounding a well-preserved, 9,000-year-old human skeleton called Kennewick Man.

Other Relevant Lesson Plans from NOAA's Office of Ocean Exploration and Research

The Robot Archaeologist

(17 pages, 518k) (from AUVfest 2008)

<http://oceanexplorer.noaa.gov/explorations/08auvfest/background/edu/media/robot.pdf>

Focus: Marine Archaeology/Marine Navigation (Earth Science/Mathematics)

In this activity, students will design an archaeological survey strategy for an autonomous underwater vehicle (AUV); calculate expected position of the AUV based on speed and direction of travel; and calculate course correction required to compensate for the set and drift of currents.

Where Am I?

(7 pages, 264 kb) (from the 2003 Steamship *Portland* Expedition)

<http://oceanexplorer.noaa.gov/explorations/03portland/background/edu/media/portlandwhereami.pdf>

Focus: Marine Navigation and Position-finding

In this activity students will be able to identify and explain at least seven different techniques that have been used for marine navigation and position finding, explain the purpose of a marine sextant, and use an astrolabe to solve practical trigonometric problems.

By Land or By Sea or Both?

(14 pages, 1.1 Mb) (from the Exploring the Submerged New World 2009 Expedition)

<http://oceanexplorer.noaa.gov/explorations/09newworld/background/edu/media/landsea.pdf>

Focus: Watercraft in Paleoamerican Migrations

In this activity, students will describe evidence that supports the idea that the initial settlement of North and South America involved watercraft, discuss types of watercraft that might have been involved in new world settlement, and explain at least three advantages and three disadvantages of coastal settlements compared to inland settlements.

The Ridge Exploring Robot

(27 pages, 1.6 mb) (from the INSPIRE: Chile Margin 2010 expedition)

<http://oceanexplorer.noaa.gov/explorations/10chile/background/edu/media/robot.pdf>

Focus: Autonomous Underwater Vehicles/Marine Navigation

Students will explain a three-phase strategy that uses an autonomous underwater vehicle (AUV) to locate, map, and photograph previously undiscovered hydrothermal vents, design a survey program to provide a photomosaic of a hypothetical hydrothermal vent field, and calculate the expected position of the AUV based on speed and direction of travel.

X-Storms

(5 pages, 384k) (from the 2003 Steamship *Portland Expedition*)

<http://oceanexplorer.noaa.gov/explorations/03portland/background/edu/media/portlandstorm.pdf>

Focus: Extreme storms (Earth Science)

In this activity, students identify and explain three factors that contributed to extreme storm conditions during the Halloween Nor'easter of 1991, discover how to obtain real-time and historical meteorological data, and compare and contrast extra-tropical cyclones, tropical cyclones, and hybrid storms.

Now Take a Deep Breath

(14 pages, 548 Kb) (from the Exploring the Submerged New World 2009 Expedition)

<http://oceanexplorer.noaa.gov/explorations/09newworld/background/edu/media/breath.pdf>

Focus: Physics and physiology of SCUBA diving (Physical Science/Life Science)

In this activity, students will be able to define Henry's Law, Boyle's Law, and Dalton's Law of Partial Pressures, and explain their relevance to SCUBA diving; discuss the causes of air embolism, decompression sickness, nitrogen narcosis, and oxygen toxicity in SCUBA divers; and explain the advantages of gas mixtures such as Nitrox and Trimix and closed-circuit rebreather systems.

Other Resources

The Web links below are provided for informational purposes only.

Links outside of Ocean Explorer have been checked at the time of this page's publication, but the linking sites may become outdated or non-operational over time.

<http://oceanexplorer.noaa.gov/10thunderbay/welcome.html> – Web site for the Thunder Bay 2010: Cutting-Edge Technology and the Hunt for Lake Huron's Lost Ships Expedition

<http://thunderbay.noaa.gov/welcome.html> – Web site for the Thunder Bay National Marine Sanctuary with links to Lesson Plans; includes grades K - 2 Boat Builder Activity, grades 3 - 5 Photomosaic

Activity, grades 3 - 5 Mapping Activity, grades 6+ Mapping Activities, Steamships and Energy Conversions, and Make Your Own Putt-Putt Boat

<http://celebrating200years.noaa.gov/edufun/book/welcome.html#book>

- A free printable book for home and school use introduced in 2004 to celebrate the 200th anniversary of NOAA; nearly 200 pages of lessons focusing on the exploration, understanding, and protection of Earth as a whole system

O'Shea, J.M. and G.A. Meadows. 2009. Evidence for early hunters beneath the Great Lakes. *Proc Natl Acad Sci* 106(25):10120-3; available online at <http://www.pnas.org/content/106/25/10120.full.pdf+html>

<http://centerfirstamericans.org/index.php> – Web site for the Center for the Study of the First Americans

<http://www.jqjacobs.net/anthro/paleoamericans.html> – Online article on issues and evidence relating to peopling of the New World

<http://www.pbs.org/wgbh/nova/first/> – Web site to accompany the NOVA presentation, "Mystery of the First Americans" (originally broadcast on February 15, 2000) documenting the discovery and controversy surrounding a well-preserved, 9,000-year-old human skeleton called Kennewick Man; includes "Does Race Exist?," "Meet Kennewick Man," "Claims for the Remains," "The Dating Game" (about carbon-14 analysis), and links to resources

<http://www.nps.gov/history/aad/eam/index.htm> – National Park Service Archaeology and Ethnography Program's Web site, The Earliest Americans

Goebel, T., M. R. Waters, and D. H. O'Rourke. 2008. The Late Pleistocene Dispersal of Modern Humans in the Americas. *Science* 319:1497-1502. <http://www.sciencemag.org/cgi/content/abstract/sci;319/5869/1497> Full article available from *Science Magazine* for \$15.

Bowdler, S. 1997. The Pleistocene Pacific. In D. Denoon (ed). *The Cambridge History of the Pacific Islanders*. pp. 41-50. Cambridge University Press, Cambridge. Article by Bowdler is available on line at http://www.archaeology.arts.uwa.au/about/research/boulder/the_pleistocene_pacific.

National Science Education Standards

Content Standard A: Science As Inquiry

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

Content Standard G: History and Nature of Science

- Science as human endeavor
- Nature of scientific knowledge
- Historical perspectives

Ocean Literacy Essential Principles and Fundamental Concepts

Essential Principle 2.

The ocean and life in the ocean shape the features of the Earth.

Fundamental Concept Fundamental Concept b. Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas, and shaped the surface of land.

Fundamental Concept e. Tectonic activity, sea level changes, and force of waves influence the physical structure and landforms of the coast.

Essential Principle 6.

The ocean and humans are inextricably interconnected.

Fundamental Concept a. The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health.

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

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

Fundamental Concept d. Much of the world's population lives in coastal areas.

Essential Principle 7.

The ocean is largely unexplored.

Fundamental Concept a. The ocean is the last and largest unexplored place on Earth—less than 5% of it has been explored. This is the great frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation.

Fundamental Concept d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

Student Handout

Ancient Hunters of the Great Lakes

1. The Clovis First theory proposes that the first human inhabitants of North and South America crossed a land bridge from Siberia at some time before 13,000 years ago. These people were sophisticated hunters, and spread rapidly across North America. This theory was proposed after stone spear points were discovered near Clovis, NM with an estimated age of 11,200 years.

Does evidence from an archaeological site named Monte Verde support or conflict with the Clovis First theory? Explain why.

2. What is Beringia?
3. How do discoveries at Meadowcroft Rock Shelter, Paisley Cave, and the Page-Ladson site relate to the Clovis First theory?
4. What is the “ice-free corridor hypothesis,” and how is it related to the Clovis First theory?
5. Who is Carol Mandryk and what does her research show?
6. If inland migration routes were blocked by ice until at least 14,000 years ago, how could people have entered North America to inhabit sites such as Meadowcroft, Paisley Cave, and Page-Ladson?
7. What is the significance of Arlington Springs to the Clovis First theory and alternative migration routes?
8. How does the arrival of humans in Australia relate to findings at Arlington Springs?
9. What do DNA studies reveal about when early Americans may have left Asia?
10. The Clovis First theory was vigorously debated for decades. Commenting on the controversy, Bonnicksen and Turnmire (1999) state:

“In scientific research, debate should be regarded as a normal part of the process of advancing knowledge. Unfortunately, the debate over the peopling of the Americas has not operated in this manner. Rather than using the debate as a positive forum for testing competing hypotheses about the initial peopling of the Americas...a very conservative group of Late-Entry advocates has systematically attacked all claims for pre-12,000-year-old-occupation in the Americas...Perhaps the worst consequence of the debate is that it has become next to impossible to raise research funds through competitive grantsmanship to conduct research at archaeological localities that may be greater than 11,500 years old.”

How do you think the scientific method should be applied to resolving this type of debate?
What would be the effect of not studying sites that might be more than 11,500 years old?