

# DUGOUT CANOES

## Paddling *through the Americas*

### Educator Guide







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*Dugout Canoes: Paddling through the Americas* is an interactive, bilingual exhibition produced by the Florida Museum of Natural History with support from the Alachua County Tourist Development Council, AEC Trust, Lastinger Family Foundation and State of Florida Matching Gifts Trust Fund.

This object-rich exhibition features American dugouts from ancient times to the present, and illustrates ways they have affected life and travel throughout the Americas, from Florida to the Amazon and the Pacific. Discover the world's largest archaeological find—101 ancient dugouts at Newnans Lake, Florida, and how scientists study dugouts from the past. Learn how the dugout tradition is alive and well in Native communities today.

This educator guide provides an outline of the exhibit components; suggestions for themed visits including relevant discussion topics, and questions to investigate during the visit; classroom activities; education standards addressed in the exhibit; and detailed information about the exhibit's content.



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## Table of Contents

Introduction .....	4
Exhibit Walk-Through.....	5
Major Exhibit Themes .....	9
Themed Visits .....	10
Classroom Activities .....	23
Educational Standards .....	39
Background Information .....	47



## Introduction

A drought in spring and summer 2000 caused historically low water levels at Newnans Lake near Gainesville, Florida. Because areas of the lake bottom were exposed, a group of students discovered an unprecedented find of 101 dugout canoes, subsequently studied by archaeologists.

This exhibit examines the dugout canoe discovery in detail, while placing the find into a larger context. Fourteen exhibit components allow visitors to explore many aspects of traditional life and modern science. The major exhibit themes are Cultural Diversity, Science of Studying the Past, Environment and Engineering. These themes are aligned with national and Florida education standards for grades K-12, and provide a framework for educators to guide students before, during and after a visit. Classroom activities and experiments further enhance students' engagement.





## Exhibit Walk-Through

The 14 exhibit components are listed below, along with the major concept in *italics*, specific points, questions and activities for visitors.

### Introduction

*Since ancient times, people of the Americas have relied on canoes for daily life and worldly connections.*

- What is a dugout? A large panel image depicts people with food in a dugout canoe. It introduces the use of dugouts and the idea that art reveals details about past cultures.

### 101 Dugout Canoes: The World's Largest Find

*Severe droughts in 2000 exposed at Newnans Lake, Florida, the largest group of prehistoric dugouts ever found.*

- A diorama represents the scene of the archaeological find. What were the environmental conditions that allowed the discovery to be made?
- Interact with the tools of archaeologists, read field notes, measure the canoe and draw the findings.
- Use a phone to hear the state archaeologist describe how to handle the canoe discovery.
- On an interactive panel, identify canoe locations and the three main time periods to which they were dated: 500-1,400 years ago, 2,300-2,700 years ago, and 3,000-5,000 years ago. Why is there a gap in the record 1,400 - 2,300 years ago? What was Florida like during these times? How did people travel?
- Learn the possible reasons for the large number of canoes found in one place, including environmental conditions or intentional activities by the canoe makers.
- Watch a video, *101 Canoes*, featuring students and researchers discussing the find.

### Dugout Science—What can we learn from canoes?

*Scientists sample old canoes to determine their age and wood type. They also may try to preserve the whole canoe.*

- Compare cross-sectional wood samples and use a microscope to determine the canoe's wood type.
- Read about the scientific methods used to study ancient canoes, including the process of dating using carbon-14 atoms, techniques for conserving old wood and wood identification.
- The video, *Canoes in the Lab*, explores wood identification and conservation techniques.



## Archaeological Dugouts

*Dugout canoe finds are rare and not always recorded.*

- Identify the sites where canoes were found in the United States and Canada, with the oldest being 6,000-7,000 years old. Where have most dugouts been found?
- Read about canoe discoveries in article excerpts published over 30 years.

## Canoe Clues

*Archaeologists search for evidence of canoes, beyond the canoes themselves.*

- What other evidence do we have that explains canoe use? Learn about indirect evidence for canoe use including Native art, recorded descriptions by explorers, the presence of canals and woodchips.
- Open doors to reveal a palm fiber net, wooden miniature canoe, wooden paddle, long-distance trade item (pendant) and pictures of shell tools. The scene on the front is an artist's reconstruction of Calusa daily life in Florida.
- A display case contains wood, bone and ceramic canoe models.

## Fishing and Gathering

*In ancient times and today, canoes have expanded options for finding and carrying food and other goods.*

- Observe different methods for obtaining food from the 16<sup>th</sup> to 21<sup>st</sup> centuries including spears, nets and hands. How has fishing and food gathering with canoes changed over time? How has it stayed the same?
- View a wooden tackle box from the 19<sup>th</sup> century and other fishing artifacts from pre-Columbian to modern age. What materials were used to make these tools?

## How do you make a dugout canoe?

*No matter where people lived, they made dugouts in similar ways.*

- Identify the steps for making a dugout, including chopping down a tree, debarking, hollowing with controlled fire, finishing and shaping. The large model of a partially made dugout shows the process of construction.
- Observe pictures of modern canoe making.
- Compare tools made of stone and shell before contact with Europeans with tools made of metal after contact. How were they used to make a dugout? Why did people change from stone and shell tools to metal tools after contact with Europeans?
- Watch the video *Carving Cultural Connections*.





## Try to sit in this canoe

*The bottom line—sit, stand or use a seat—can you fit in this canoe?*

- Sit in a dugout canoe from Panama and consider the skills needed for balance and movement. How many people could fit in this canoe? What else could fit inside the canoe? How would early people use a canoe like this one?

## Ancient Dugouts, Paddles and Poles

*Ancient dugouts came in various shapes, sizes and configurations.*

- Examine a pine canoe made by Timucuan people in Florida about 500 years ago. How is this canoe different from modern canoes? How is it similar?
- Observe archaeological pine paddles from 2,000 years ago and pictures of European artwork detailing canoe use.

## Ancient Styles

*Dugout canoe styles are widely diverse throughout the Americas.*

- Touch an ancient canoe fragment of pine found in Florida (Suwannee River) and six made-to-scale canoe replicas: Northwest Coast whaling dugout (Haida, British Columbia), Pacific ceremonial dugout (Hawai'i, Hawaii), Gulf Coast dugout (Weeden Island culture, Florida), Northeastern dugout (Pennsylvania), Caribbean dugout (Ngobe, Panama) and Amazonian dugout (Brazil).

## Modern Dugouts

*Today, people throughout the Americas continue to make dugout canoes.*

- Observe the Vancouver Island canoe. What do the designs on the ends represent?
- Compare display models of other modern canoes. A panel shows photos of modern canoes in use in the Amazon, Ecuador, Panama and Guatemala.
- Learn where canoe use has been revived in the United States. Why is it important to revitalize ancient traditions?

## Modern Paddles

*Paddle shapes often differ depending on local customs and environments.*

- Compare the uses for different shaped paddles. Why is the shape of the paddle important?
- Observe modern paddles from all over the Americas.
- Use a stencil to draw and decorate a paddle.





## Travel and Trade

*In the ancient world, canoes allowed people to travel further and faster.*

- Archaeologists find non-local goods in sites throughout the Americas, sometimes hundreds and even thousands of miles from their source. How could this happen?
- Learn why ancient people used canoes including trade, politics and social customs.
- Identify items and their countries of origin that may have been traded by ancient people via canoes.

## Sacred and Social

*In some cultures, canoes have been so vital that they have taken on sacred meaning.*

- Observe pictures of canoes appearing in sacred art and ceremony. Why are canoes sacred to these cultures?
- Display case shows sculptures of canoes in Haida myth.
- Create a rubbing of a Mayan image showing 'paddler Gods' with ruler Hasaw.
- Listen to the Suquamish poem, *Canoes Coming In*.



## Ancient Canoeing

*This scene represents an ancient canoe-building site in Florida.*

- Observe the diorama to see an artist's reconstruction of what daily life might have been like. What is happening in this scene? What is each person doing?
- Is this truly how people lived? We're not sure. This scene shows one possibility based on archaeological and historic evidence. Archaeologists and sculptors use artifacts and historic documents to create scenes like this.







## Major Exhibit Themes

### Cultural Diversity

Basic human activities such as migration, trade, religion and procuring food are present in society now as well as thousands of years ago. This exhibit illustrates the long history of canoe use in the Americas up until the present time. Long before Europeans colonized the Americas, Native Americans had rich and complex cultures. Visitors will learn about different groups, how they lived, their relationship with one another and the environment, and how some Native Americans live today.

### Science of Studying the Past

A variety of methods are used to understand the purpose and context of artifacts, including scientific experimentation, art, writing and indirect evidence from associated artifacts. Visitors can use and learn about different tools such as microscopes, carbon-14 dating, archaeological measurement, primary source documents and artwork. They can view artifacts that indirectly suggest canoe use including objects used for fishing and long-distance trade items.

### Environment

Preservation of ancient wooden canoes depends in part on environmental conditions. The conditions responsible for archaeological finds are explored, particularly with respect to changing water levels. Why is there a unique record of canoe use at Newnans Lake? Human dependence upon available natural resources for meeting needs is also explored. What materials did the Native Americans discussed in the exhibit use?

### Engineering

Native Americans fashioned tools to meet their needs from materials available around them, including wood, shells and bone. Designing a functional canoe is a complex process that required consideration of physics, resource availability, different needs for the same object and spiritual considerations. This exhibit will teach visitors about the many aspects of designing and building a canoe and allow interactive exploration of this topic.



## Themed Visits

This section outlines a visit to the exhibit focused on four major themes. By investigating each theme in detail, visitors will have a more directed experience in the exhibit and be encouraged to place the exhibit within a larger context. For each theme, relevant topics are presented for the visitor to consider before or after the visit. These topics can be adapted for any age and address many of the curriculum standards.

School groups may wish to consider having students break into four teams with each team responsible for one of the themes. After the visit, teams can present their results to the class. Activities based on the themes can be incorporated into the classroom before or after the visit.



## Theme 1: Cultural Diversity

### Topics to consider:

- Potential uses for a canoe; modern analogies for canoes
- Similarities and differences in human behavior across different cultures
- History and culture of Native Americans
- Learning about culture through art, writing and artifacts

### Classroom activities:

- Canoe patterns
- Write a short story or poem about a possible day in the lives of people in a Native American culture.

### During the visit:

1. What were some purposes of canoes in ancient times? How do we know this?
2. What do we use now, instead of canoes, for these purposes?
3. What are some purposes of modern canoes?

4. Which groups of Native Americans are mentioned in the exhibit? Where and when did they live?

5. What types of objects did different cultures trade or exchange with each other? How do we know? Why is trading important?

6. Observe the diorama showing daily life of a Native American culture. What is happening? What are some specific tasks each person is doing? What are some chores that a child might do?



7. Below, create a rubbing of a Mayan image showing 'paddler Gods' with ruler Hasaw. What do you think the image means?

## Theme 2: Science of Studying the Past

### Topics to consider:

- Different types of evidence to study the past (e.g. direct/indirect; primary and secondary sources)
- Preservation of artifacts under different conditions and different types of material based on properties of matter
- Biases of the archaeological and historical record
- Scientific methods to date material using known atomic decay rates
- Tools of an archaeologist

### Classroom activities:

- Observation vs. Inference
- Archaeology in context

### During the visit:

1. How does an archaeologist investigate a new site?
2. Draw or list the tools she or he uses.
3. When were the canoes found at Newnans Lake made? How do we know this?



4. List all of the evidence you can find in the exhibit for canoe use by Native Americans.

5. What type of material was used to make the canoes found at Newnans Lake?  
How do we know?

6. Draw what you see under the microscope. Which type of wood is the specimen?

7. Did the fact that the canoes were found in water make the job of the archaeologists more difficult? How did they overcome this?

8. Pretend you are an archaeologist called to the Newnans Lake site. Create a field notebook entry based on your observations of the model canoe and diorama of the Newnans Lake site.

Date: \_\_\_\_\_

Location: \_\_\_\_\_

State: \_\_\_\_\_ Country: \_\_\_\_\_

Description of the scene:

Number of canoes found: \_\_\_\_\_

Draw one of the canoes. Label how long it is based on the measurements you took.

Report of your conversation with the state archaeologist  
(use the telephone to call him!)

Other details:



## Theme 3: Environment

### Topics to consider:

- Limited availability of non-renewable resources (e.g., fish, trees)
- Ancient versus modern ways of using resources
- Impact of the environment on cultural decisions
- Changing environmental conditions affect the archaeological record

### Classroom activity:

Float my Boat I

### During the visit:

1. Describe the natural weather event that allowed the discovery of the Newnans Lake canoes.

2. What type of material was used for the Newnans Lake canoes? Why did they use this?

3. Draw a timeline of canoe finds at Newnans Lake. Is there a gap? Why?

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4. What types of natural resources were available to Native Americans?

5. List all of the materials used to make woodworking tools that are shown in the exhibit.

6. Why were so many canoes found together at Newnans Lake? What was the potential use(s) of this site?

7. Draw a timeline of when canoes were used in the Americas, from the earliest dated site to the present. Give specific examples from the exhibit.

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8. When was the oldest canoe used?

Do you think people made canoes before then? Why or why not?



9. Label the places where canoes were found in the Americas.



10. Do they tend to cluster in certain areas? Why? Why not?

## Theme 4: Engineering

### Topics to consider:

- Properties of potential materials for making canoes and paddles (e.g., buoyancy, durability, availability)
- Design features for different uses of paddles and canoes (e.g., speed, cargo space, directional ability)

### Classroom activity:

Float my Boat II

### During the visit:

1. How did Native Americans make the canoes? How do we know?
2. Draw/write the steps for making a dugout canoe as though you were creating an instruction manual.
3. Did the way canoes were made change over time? How do modern Native Americans make canoes?



4. What are important features to consider when designing a canoe? How would your design change depending on which feature was most important?

5. What is the best type of material to use to make a canoe? How would you decide what to use?

6. Sit in the canoe. How many people fit into it? Would you make the canoe longer so that more people could fit? Why or why not?

7. What are the possible uses for paddles? How does the design affect their use?  
Draw different types of paddles and label their uses. Use a stencil to draw and decorate a paddle.



# Classroom Activity: Archaeological Context

*Adapted from Wisconsin Historical Society*

## Overview

It is important to reinforce the point that artifacts must remain in *context* to provide the most information possible about a given site. This activity facilitates contextual thinking by allowing the students to practice the analytic skill of classification in conjunction with context-building. You can use the discussion to help students arrive independently at the conclusion that context clues help us understand more about the cultures of people—past and present.

## Objective

- Students will demonstrate the importance of analyzing objects in context for learning about past people.

## Materials

- Index cards
- Pencil and paper for each group

## Introduction

Ask students: If I had never met you and walked into your bedroom, what would I know about you from the things you have there? Would I know what your interests are? Would I know if you share your room?

Think of something in your bedroom that is very special to you. What does that object, along with everything else in your room, tell about you? Everything together provides an informative context. You have selected certain things to have, and together these things tell about you.

Now imagine that your special object has been taken from you and is found in the city park. How does this change what could be known about you? When it is removed from your room, the object alone tells nothing, and your room is now missing an important piece of information about you. Context has been disturbed, and information about you is lost.

## Procedure

1. Divide students into small groups and assign each group a number. Give each student an index card with the group number written on the back.
2. As a group, they are to choose a room or type of building, such as a hospital operating room, kitchen or hardware store. Keep their selection a secret from the other groups. They decide what objects (artifacts) in the room make it distinctive.
3. Each student writes one object on his/her card and the group cards are stacked together.
4. The stack of cards from each group is passed to the next group. They will try to infer the identity or function of the location based on the artifacts listed on the cards.

5. The cards will continue to be passed until all groups have worked with all of the card sets—however, each time before the cards are passed, a student will remove one card so that fewer and fewer objects remain as the cards are passed on. The removed cards should be placed off to the side so they are not mixed with the other sets of cards.
6. Discuss results. How many groups correctly guessed the functions of the different locations? Is one object taken out of context (like a card removed at random) able to give as accurate a picture as are all of the objects in their place of origin?

### Closure

During discussion, students describe what they have learned about the significance of context. Artifacts in context are the basis for all understanding about the people who were living in North America before Europeans arrived; archaeology is a science of context. Removing artifacts from a site removes them from their context and makes it very difficult to get a complete understanding of past people.

Imagine that an archaeologist found your classroom thousands of years from now. Make a statement about how artifacts in the context of your classroom will enable the archaeologist to learn about your class. Create a hypothetical time capsule of 10 articles that they think will be the greatest help in explaining what goes on in your classroom.

### Extension

Show the students an artifact with which they would not be familiar, like a coffee percolator or an adding machine, and have the students hypothesize how people may have used this artifact. This activity and discussion should help students understand the difficulty that archaeologists sometimes have in interpreting unfamiliar objects.



# Classroom Activity: Observation & Inference

*Adapted from "Intrigue of the Past: North Carolina's First Peoples," Research Laboratories of Archaeology, University of North Carolina at Chapel Hill*

## Overview

Science is based on *observation* and *inference*. Any phenomenon being studied must first be observed, whether it be from a satellite or through a microscope. An inference is a reason proposed to explain an observation. The *hypothesis* is a chosen inference that the scientist will attempt to confirm or disprove through testing.

Archaeologists use observation and inference to learn the story of past people. By making observations about objects (artifacts and sites) they infer the behavior of the people who used the objects. When archaeologists find the remains of a village (observation), they could infer that the people were farmers. To test this inference (hypothesis), they would look for evidence of farming, such as farming implements (e.g., stone hoes) and food remains from crops (e.g., corn cobs, squash seeds). If they find these objects, their hypothesis is verified. Archaeologists construct careful hypotheses when making inferences from archaeological *data*.

## Objectives

- Students will differentiate between observation and inference through a problem-solving approach.
- Students will demonstrate their knowledge by analyzing an archaeological artifact and creating their own observation-inference statements.

## Materials

- Algonkian Boat Building activity sheet and master

## Introduction

Present students with a possible observation-inference scenario from their lives.

**Example:** All the students in the classroom came to school on Tuesday, but did not come on Monday (observation). What many and varied reasons (proposed inferences) might there be for their absence on Monday? Examples: holiday, sleet storm, teacher workday, fire at school Sunday night.

In what ways might one or more of these inferences (hypotheses) be tested in order to come to a conclusion about the absence? Examples: Look at the calendar to see if there was a holiday on Monday; check the weather report; ask the teacher if Monday was a teacher workday; ask the local fire department if they responded to a fire at the school on Sunday.

## Procedure

For Algonkian Boat Building:

1. Project or distribute the Algonkian Boat Building activity sheet.
2. Read each statement and ask students to decide if it is a statement of observation or of inference. Ask them to give reasons for their answers.
3. How might one or more of the inferences (hypotheses) be tested?
4. Have students develop definitions for observation, inference and hypothesis.

## Closure

Ask students to summarize what they learned about the importance of observation, inference and hypothesis testing in archaeology.

## Extension

Give each student or team a foreign or U.S. coin and ask them to imagine they have found the coin at an archaeological site. They will create a list of observation statements and inference statements about the coin. Have them choose one inference as their hypothesis and describe how they might test it.



## Algonkian Boat Building

Place an “I” before the statements that are inferences and an “O” before the statements that are observations.

- \_\_\_\_\_ 1. There are four men in the picture.
- \_\_\_\_\_ 2. The two men near the fires are fanning the fires.
- \_\_\_\_\_ 3. It is summer.
- \_\_\_\_\_ 4. The tree on the ground has no leaves on it.
- \_\_\_\_\_ 5. The tree on the ground is a hundred years old.
- \_\_\_\_\_ 6. Squirrels lived in the tree on the ground.
- \_\_\_\_\_ 7. There is a low fire at the base of a standing tree.
- \_\_\_\_\_ 8. One of the men started the fire at the bottom of the tree.
- \_\_\_\_\_ 9. That tree, like the one on the ground, is a tall, thick tree.
- \_\_\_\_\_ 10. The men want tall, thick trees so they can build boats.
- \_\_\_\_\_ 11. Two men are making a long cavity in a tree trunk by letting fire burn the wood away.
- \_\_\_\_\_ 12. The hollowed tree is raised off the ground by forked tree posts.
- \_\_\_\_\_ 13. The two men at the hollow tree trunk are friends.
- \_\_\_\_\_ 14. The men’s hair is short except for the longer strip in the middle.
- \_\_\_\_\_ 15. The fires will burn the whole forest down.
- \_\_\_\_\_ 16. Deer live nearby in the woods.
- \_\_\_\_\_ 17. The men are tired.
- \_\_\_\_\_ 18. The tree with the fire in the cavity has no bark.
- \_\_\_\_\_ 19. Smoke is getting into the men’s eyes.
- \_\_\_\_\_ 20. The men are close to their village.





Engraving originally published by Theodor de Bry in 1590, based on a painting by John White made in 1585.



## Answer Key: Algonkian Boat Building

Place an “I” before the statements that are inferences and an “O” before the statements that are observations.

- O   1. There are four men in the picture.
- I   2. The two men near the fires are fanning the fires.
- I   3. It is summer.
- O   4. The tree on the ground has no leaves on it.
- I   5. The tree on the ground is a hundred years old.
- I   6. Squirrels lived in the tree on the ground.
- O   7. There is a low fire at the base of a standing tree.
- I   8. One of the men started the fire at the bottom of the tree.
- O   9. That tree, like the one on the ground, is a tall, thick tree.
- I   10. The men want tall, thick trees so they can build boats.
- I   11. Two men are making a long cavity in a tree trunk by letting fire burn the wood away.
- O   12. The hollowed tree is raised off the ground by forked tree posts.
- I   13. The two men at the hollow tree trunk are friends.
- O   14. The men’s hair is short except for the longer strip in the middle.
- I   15. The fires will burn the whole forest down.
- I   16. Deer live nearby in the woods.
- I   17. The men are tired.
- I   18. The tree with the fire in the cavity has no bark.
- I   19. Smoke is getting into the men’s eyes.
- I   20. The men are close to their village.

# Classroom Activity: Float My Boat I

*Adapted from Duke University's Center for Inquiry Based Learning*

## Overview

Each student uses a variety of materials to create an object that will float in a tub of water. This activity is an introduction to further investigations about density and buoyancy.

## Objectives

- Students will strengthen creative thinking and problem-solving skills in science and math as they explore boat-making.
- Students will be able to list types of materials that float and sink in water.

## Materials

- Chart paper and marker
- Large container filled with water
- Scissors
- Glue and tape
- Sponges
- Styrofoam (large pieces or cups, bowls, or small plates)
- Wood scraps
- Cardboard scraps or small boxes and lids
- Egg cartons
- Paper tubes and straws
- Foil wrap
- Plastic containers
- Variety of paper: oak tag, tissue paper, construction paper

## Introduction

Collect several small plastic tubs (such as butter containers), marbles, wooden blocks, pompoms and small toys. Place the empty tubs in a container of water. Ask students to predict what will happen when different objects are placed into the empty containers. Will the tub sink or float? Encourage children to experiment with different materials.

## Procedure

1. Engage students in a discussion about boats. Ask them to share what they know about boats.
2. Set out the materials and instruct students to make their own boats to use for floating/sinking experiments. Encourage students to be creative with their boat-making.
3. Students can test their completed boats in the large container filled with water. Explain that some boats may float and others may not, and that if their boat doesn't float, they can make another one. Ask them to observe which boats float and which ones sink. Record observations for the class on chart paper.



## Investigating Questions

Stimulate a discussion by asking questions referring to experiences students had while creating and floating their boats. Refer to their recorded observations.

- Why did some boats sink and others float?
- What boat designs worked best? Why?
- Are the boats that float made of similar materials or are they similar sizes?
- Does the size of the boat matter?
- What boat designs didn't work well? Why?
- If your first boat sank, what design changes did you make?

## Extension

Students will likely have a number of observations about the shapes of successful boats, and express some curiosity about “real” boats and their design features. They may also wonder what allows a boat to float in the first place. Thus, investigating density and buoyancy are two obvious directions for extending this exercise.



# Classroom Activity: Float my Boat II

*Adapted from PBSKids.org*

## Background Information

If someone throws a rock in the ocean, it sinks. But a ship, which has a weight many times that of a rock, manages to float in the water. This interesting phenomenon known as *buoyancy* is the reason that boats float. The properties of buoyancy were first described by the Greek mathematician Archimedes, in what we now call Archimedes' principle. This principle states that any object, wholly or partly immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object.

When an object is placed into a fluid, the level of the fluid rises, because the object has displaced some of the liquid. Any object placed in water will displace its own weight or *volume* in water, whichever comes first. This is called the weight-to-surface area ratio.

Different materials which have different densities but equal volume will have a different buoyancy. For example, a bowling ball will sink, while a balloon filled with air will float, even though they occupy the same volume in space. This is due to the greater density of the bowling ball. Unlike a balloon, a bowling ball weighs more than the weight of the water it displaces, so the ball has a low surface area-to-weight ratio.

A boat is essentially a hollow shell filled with air, meaning that it has a large surface area-to-weight ratio. Therefore, the boat will still be well above the surface when it has displaced its equivalent weight in water.

Boats float because of their design. When a boat is heavily laden, it will settle lower in the water, because its surface area-to-weight ratio is different than when the boat is light. A boat will remain floating and stable provided it is not overloaded.

Once someone knows how boats float, he or she can imagine how it is that other objects float. From pieces of wood to ducks, an object's surface area-to-weight ratio dictates its buoyancy. This also explains why boats sink: if the hull of a boat is breached, it begins to take on water, which makes it denser, causing it to displace more water. If the boat takes on enough water, it will become too heavy to remain buoyant.

## Overview

How do boats float? Even large ships weighing hundreds of thousands of tons stay afloat. Students will investigate the physics of floating by building foil boats and loading them with pennies until they sink. Through design and testing, students will discover that a boat's size and shape make a difference in how much of a load it can carry. They will make inferences, refine hypotheses and draw conclusions about some of the basic principles of boat design and gain first-hand experience with concepts such as buoyancy and density.

## Objectives

- Students will use scientific processes to help them create a boat that floats.
- Students will demonstrate the principles of buoyancy such as gravity, pressure, density and displacement.

## Materials

- Activity sheets
- Six to 10 6-inch squares of aluminum foil per group
- Pennies or washers (100 per group)
- One dishpan or bucket half-filled with water per group
- Towels to place under bucket
- Rulers
- Sticky notes or pieces of scrap paper

## Introduction

Explain that today's challenge is to learn how things float by making foil boats that can carry a load of pennies or washers.

## Procedure

### Part 1: Build boats (25 minutes)

*Part 1 helps students figure out the basics of boat building and loading pennies. It prepares them for a discussion of boat design and capacity.*

1. Hand out the activity sheets and have students do steps 1–4. Tell students to keep each boat they make and to record the number of pennies each boat held in the data table and on the sticky notes (one per boat). After Part 1, they will display each of the boats they made with its corresponding sticky note. (10 minutes)
2. Bring the group together. Have students put their boats and sticky notes in a sequence from the least pennies held to the most, like a number line. (5 minutes)
3. Discuss what happened. What features do boats that hold a lot of pennies have in common? *Size—big boats hold more pennies; strength—sturdy boats don't crumple under a load; and stability—wide boats don't roll over as easily as narrow boats.*

Explain that when a boat floats, it pushes aside (i.e., displaces) water to make room for itself. But, the water around the boat pushes back. And the more water a boat displaces, the more force there will be pushing back on the boat. This force (called buoyancy) supports the boat. Boats that displace a lot of water can generally carry a heavier load than boats that displace only a little water. Observe the boats made in Part 1 that confirm this idea. (10 minutes)

4. After the discussion of what kinds of boats hold a lot of pennies, list ways to make a boat that carries a heavy load. *Help students see the connection between how much water a boat displaces and how much it can carry.* (5 minutes)

### Part 2: Build more boats (25 minutes)

1. Now that students understand that displacing water is related to how much a boat can carry, have them refine and retest their designs by completing Part 2 on their activity sheet. Students should keep their champion boat—the one that carried the most pennies—and record how many pennies it held. (10 minutes)
2. Gather as a group and share effective designs. Have each student show the group their champion boat. Compare boats that held similar numbers of pennies. How are they alike and different? *Students may simply describe the boats' features. Remind them about the role of displacement. Boats holding similar numbers of pennies should displace similar amounts of water.* (15 minutes)



**Review the activity's key ideas by asking the following questions.**

- What are some things that happen when you add more pennies to your boat? *Answers include: making the boat weigh more and having it sink lower into the water. Also, foil boats often bend when they're heavily loaded and tip when they're unevenly loaded.*
- Why do boats float? *Water pushes on the bottom and sides of a boat, holding it up. What kinds of features help boats hold a lot of pennies? Answers may include a large size, sturdy construction and stable shape.*
- What would a foil boat that pushes aside a lot of water look like? *It would have medium-sized bottoms and medium-sized sides. This combination displaces more water than a boat with a large bottom and small sides or one with tall sides and a small bottom.*
- Doing science involves making predictions, testing them (which includes making observations and inferences, and drawing conclusions) and sharing your results. Give an example of how we did these steps today. *Answers will vary.*





## Activity Sheet

Today, your challenge is to build foil boats and test different designs to see how many pennies you can load without sinking your boat. Place pennies gently onto the boats—dropping them can sink a boat that might otherwise hold a larger load.

### Part 1

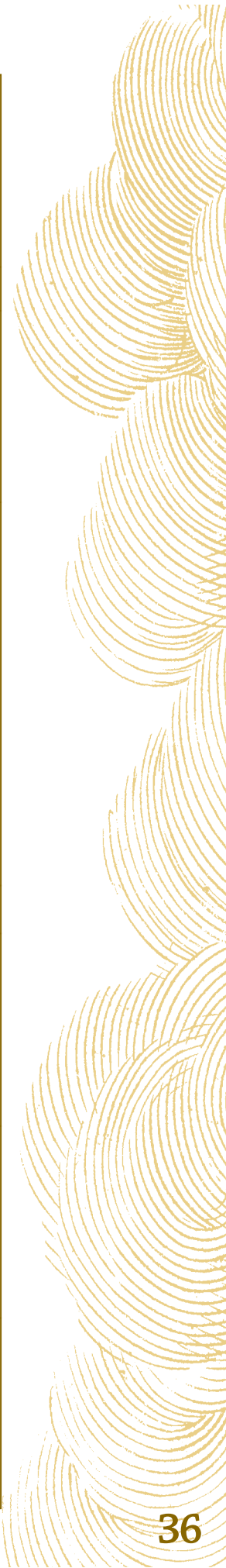
1. Build a boat out of foil. Draw your design in the data table.
2. Make predictions. In the data table, enter your prediction for how many pennies your boat can hold before it sinks.
3. Test the design. Float your boat and add pennies one at a time. Keep going until the boat sinks. Count how many pennies your boat held—but don't count the last one because it sank the boat! Enter this number in the data table and on a sticky note. Keep each sticky note with the boat used.
4. Repeat steps 1–3 two more times, making a total of three boats. Change your design each time to try and hold more pennies.
5. After you build three boats, you are finished. We will discuss results.

### Part 2

Make three new designs, using what you learned about the height and thickness of the sides, the size of the bottom and how to position the pennies. Record your designs, predictions and test results in the data table.

Data Sheet

<b>Draw Your Design</b> Label the side height, bottom length and width		<b>Prediction</b> How many pennies can this design carry without sinking?	<b>Result</b> Number of pennies actually carried
Part 1: Initial Designs			
1			
2			
3			
Part 2: Revised Designs			
1			
2			
3			





# Classroom Activity: Canoe & Kayak Patterns

From The Canadian Canoe Museum

## Objective

- Students will build a paper canoe and learn about the symbolism of canoe designs.

## Materials

- Canoe patterns
- Scissors
- Tape
- Colored pencils

## Northwest Dugout Canoe

This style of canoe is Nuuchah-nulth from the area of Fort Rupert, Vancouver Island, British Columbia. It is of Kwakwaka'wakw origin and a style used by many cultures along the Northwest Coast. The hull is hewn from red cedar with the bow and stern attached as separate pieces. This canoe is an example of one used to hunt finback and grey whales. Typically it would have carried six paddlers, a steersman and a harpooner.

Often canoes of the Northwest Coast were painted with intricate and expressive art. Native peoples in this region believed that each canoe contained its own spirit. The designs on the canoes represented aspects of the spiritual and natural world. The painted image at the bow on this canoe is a killer whale.

In this activity, you will make your own dugout canoe by cutting out the pattern and putting it together according to the diagram. Before you tape it, design your own images on the canoe. Choose images that reflect meaningful things in your life, or images from nature that are important to you.

Prior to European contact, Native peoples used naturally occurring pigments to paint their canoes. Commonly used colors were black (from charcoal or graphite), red (from ochre and hematite) and blue (from copper and iron-based metals). Use these colors for your canoe.



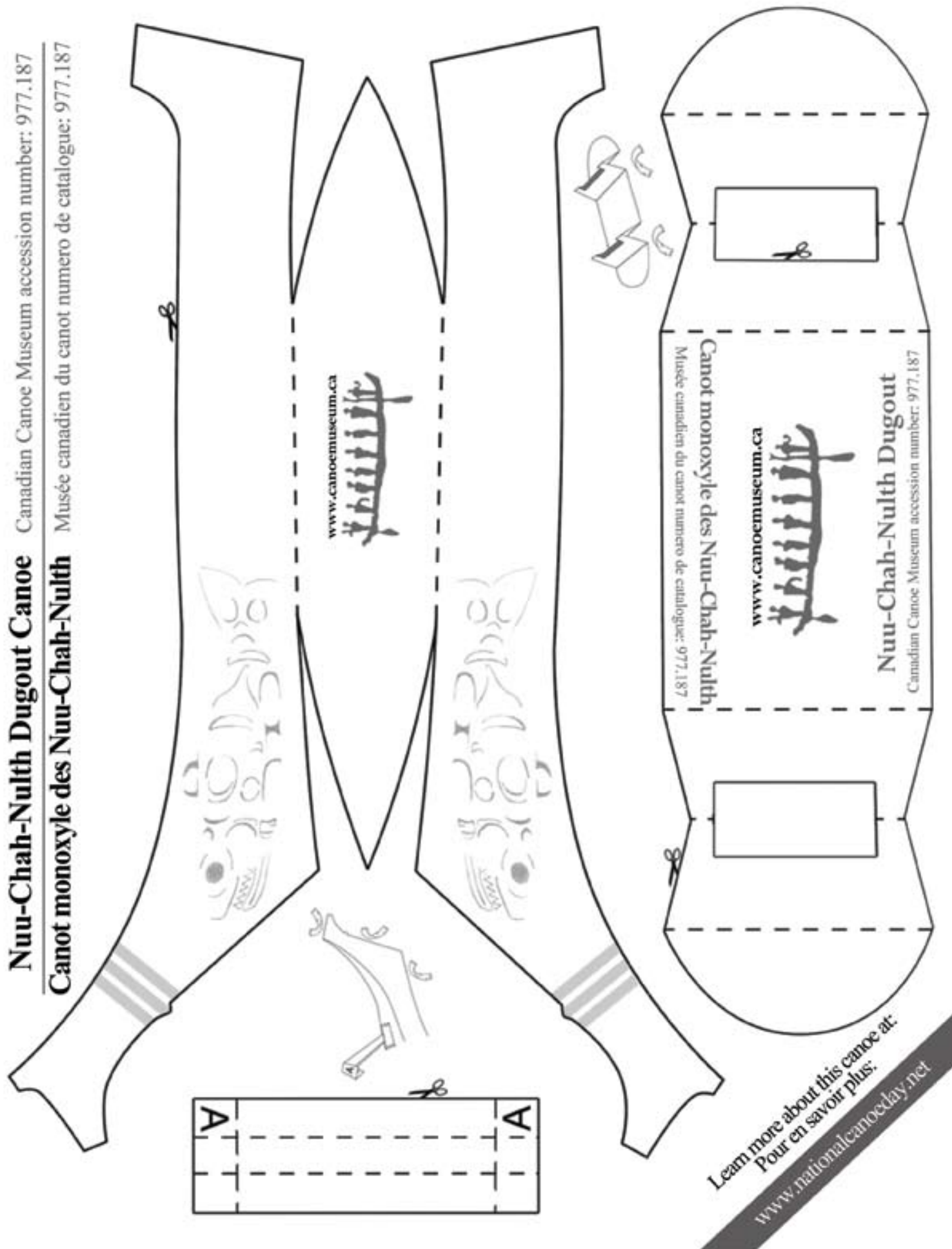
**Length:** 11.99 meters (39 feet 4 inches)

**Beam:** 1.61 meters (3 feet 6 inches)

# Nuu-Chah-Nulth Dugout Canoe

## Canot monoxyle des Nuu-Chah-Nulth

Canadian Canoe Museum accession number: 977.187  
Musée canadien du canot numero de catalogue: 977.187



# Educational Standards

## Next Generation Standards (Science)

### LS2.A: Interdependent relationships in ecosystem

- Grades K-2: Plants depend on water and light to grow, and also depend on animals for pollination or to move their seeds around.
- Grades 3-5: The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil.
- Grades 6-8: Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory and mutually beneficial interactions vary across ecosystems but the patterns are shared.

### LS4.D: Biodiversity and humans

- Grades K-2: A range of different organisms lives in different places.
- Grades 3-5: Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.
- Grades 6-8: Changes in biodiversity can influence humans' resources and ecosystem services they rely on.

### ESS2.D Weather and climate

- Grades K-2: Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.
- Grades 3-5: Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.
- Grades 6-8: Complex interactions determine local weather patterns and influence climate, including the role of the ocean.

### ESS3.A: Natural resources

- Grades K-2: Living things need water, air and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.
- Grades 3-5: Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.
- Grades 6-8: Humans depend on Earth's land, ocean, atmosphere and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.





### **ESS3.C: Human impacts on Earth systems**

- Grades K-2: Things people do can affect the environment but they can make choices to reduce their impacts.
- Grades 3-5: Societal activities have had major effects on the land, ocean, atmosphere and even outer space. Societal activities can also help protect Earth's resources and environments.
- Grades 6-8: Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.

### **PS1.A: Structure of matter (includes PS1.C Nuclear processes)**

- Grades K-2: Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.
- Grades 3-5: Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.
- Grades 6-8: The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes and conservation of matter.

## **Common Core Standards**

### **College and Career Readiness Anchor Standards for Speaking and Listening (K-12)**

- CCSS.ELA-Literacy.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
- CCSS.ELA-Literacy.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively and orally.
- CCSS.ELA-Literacy.CCRA.SL.3 Evaluate a speaker's point of view, reasoning and use of evidence and rhetoric.
- CCSS.ELA-Literacy.CCRA.SL.4 Present information, findings and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose and audience.
- CCSS.ELA-Literacy.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- CCSS.ELA-Literacy.CCRA.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

## College and Career Readiness Anchor Standards for Language (K-12)

- CCSS.ELA-Literacy.CCRA.L.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts and consulting general and specialized reference materials, as appropriate.
- CCSS.ELA-Literacy.CCRA.L.5 Demonstrate understanding of figurative language, word relationships and nuances in word meanings.
- CCSS.ELA-Literacy.CCRA.L.6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

## College and Career Readiness Anchor Standards for Reading (K-12)

- CCSS.ELA-Literacy.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
- CCSS.ELA-Literacy.CCRA.R.8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCSS.ELA-Literacy.CCRA.R.9 Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

## English Language Arts Standards Science & Technical Subjects Grade 6-8

- CCSS.ELA-Literacy.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
- CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- CCSS.ELA-Literacy.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements or performing technical tasks.
- CCSS.ELA-Literacy.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph or table).
- CCSS.ELA-Literacy.RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings and speculation in a text.
- CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic.

## English Language Arts Standards History/Social Studies Grade 6-8

- CCSS.ELA-Literacy.RH.6-8.1 Cite specific textual evidence to support analysis of primary and secondary sources.
- CCSS.ELA-Literacy.RH.6-8.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary of the source distinct from prior knowledge or opinions.
- CCSS.ELA-Literacy.RH.6-8.3 Identify key steps in a text's description of a process related to history/social studies (e.g., how a bill becomes law, how interest rates are raised or lowered).
- CCSS.ELA-Literacy.RH.6-8.4 Determine the meaning of words and phrases as they are used in a text, including vocabulary specific to domains related to history/social studies.
- CCSS.ELA-Literacy.RH.6-8.5 Describe how a text presents information (e.g., sequentially, comparatively, causally).
- CCSS.ELA-Literacy.RH.6-8.7 Integrate visual information (e.g., in charts, graphs, photographs, videos or maps) with other information in print and digital texts.
- CCSS.ELA-Literacy.RH.6-8.8 Distinguish among fact, opinion and reasoned judgment in a text.
- CCSS.ELA-Literacy.RH.6-8.9 Analyze the relationship between a primary and secondary source on the same topic.

## Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects: Text Exemplars

**Grades 2-3:** *If the World Were a Village: A Book about the World's People* by David Smith

**Grades 4-5:** *The Birchbark House* by Louise Eldrich;

**Grades 6-8:** *Twelfth Song of Thunder*, Navajo tradition

**Grades 9-10:** *Bury My Heart at Wounded Knee* by Dee Brown

## Florida Next Generation Standards (Social Studies)

### American History

#### Historical Inquiry and Analysis

- SS.K.A.1.1 Develop an understanding of how to use and create a timeline.
- SS.K.A.1.2 Develop an awareness of a primary source.
- SS.1.A.1.1 Develop an understanding of a primary source.
- SS.2.A.1.1 Examine primary and secondary sources.
- SS.3.A.1.1 Analyze primary and secondary sources.
- SS.4.A.1.1 Analyze primary and secondary resources to identify significant individuals and events throughout Florida history.
- SS.5.A.1.1 Use primary and secondary sources to understand history.
- SS.5.A.1.2 Utilize timelines to identify and discuss American history time periods.



## Historical Knowledge

- SS.K.A.2.1 Compare children and families of today with those in the past.
- SS.1.A.2.1 Understand history tells the story of people and events of other times and places.
- SS.1.A.2.2 Compare life now with life in the past.
- SS.2.A.2.2 Compare the cultures of Native American tribes from various geographic regions of the United States.

## Pre-Columbian Florida

- SS.4.A.2.1 Compare Native American tribes in Florida.
- SS.5.A.2.2 Identify Native American tribes from different geographic regions of North America.
- SS.5.A.2.3 Compare cultural aspects of Native American tribes from different geographic regions of North America including but not limited to clothing, shelter, food, major beliefs and practices, music, art and interactions with the environment.

## Chronological Thinking

- SS.2.A.3.1 Identify terms and designations of time sequence.
- SS.4.A.9.1 Utilize timelines to sequence key events in Florida history.

## Geography

### The World in Spatial Terms

- SS.K.G.1.3 Identify cardinal directions (north, south, east, west).
- SS.3.G.1.1 Use thematic maps, tables, charts, graphs and photos to analyze geographic information.
- SS.1.G.1.6 Describe how location, weather and physical environment affect the way people live in our community. (relate to Native Americans and how/where they lived)
- SS.4.G.1.1 Identify physical features of Florida.
- SS.6.G.2.1 Explain how major physical characteristics, natural resources, climate and absolute and relative locations have influenced settlement, interactions and the economies of ancient civilizations of the world.
- SS.7.G.2.3 Explain how major physical characteristics, natural resources, climate and absolute and relative location have influenced settlement, economies and inter-governmental relations in North America.
- SS.7.G.2.4 Describe current major cultural regions of North America.

### Physical Systems

- SS.K.G.3.1 Identify basic landforms.
- SS.K.G.3.2 Identify basic bodies of water.
- SS.K.G.3.3 Describe and give examples of seasonal weather changes, and illustrate how weather affects people and the environment.
- SS.3.G.3.2 Describe the natural resources in the United States, Canada, Mexico and the Caribbean.

## Human Systems

- SS.3.G.4.1 Explain how the environment influences settlement patterns in the United States, Canada, Mexico and the Caribbean.
- SS.3.G.4.2 Identify the cultures that have settled the United States, Canada, Mexico and the Caribbean.
- SS.3.G.4.4 Identify contributions from various ethnic groups to the United States.

## Economics

### Beginning Economics

- SS.2.E.1.1 Recognize that people make choices because of limited resources.
- SS.3.E.1.1 Give examples of how scarcity results in trade.
- SS.3.E.1.3 Recognize that buyers and sellers interact to exchange goods and services through the use of trade or money.
- SS.6.E.3.2 Categorize products that were traded among civilizations, and give examples of barriers to trade of those products.
- SS.6.E.3.4 Describe the relationship among civilizations that engage in trade, including the benefits and drawbacks of voluntary trade.

## World History

- SS.6.W.1.1 Use timelines to identify chronological order of historical events.
- SS.6.W.1.2 Identify terms (decade, century, epoch, era, millennium, BC/BCE, AD/CE) and designations of time periods.
- SS.6.W.1.3 Interpret primary and secondary sources.
- SS.6.W.1.4 Describe the methods of historical inquiry and how history relates to the other social sciences.
- SS.912.W.1.3 Interpret and evaluate primary and secondary sources.
- SS.912.W.1.4 Explain how historians use historical inquiry and other sciences to understand the past.

## Humanities

- SS.912.H.1.1 Relate works in the arts (architecture, dance, music, theatre and visual arts) of varying styles and genre according to the periods in which they were created.
- SS.912.H.1.3 Relate works in the arts to various cultures.
- SS.912.H.1.6 Analyze how current events are explained by artistic and cultural trends of the past.
- SS.912.H.3.1 Analyze the effects of transportation, trade, communication, science and technology on the preservation and diffusion of culture.

## Florida Next Generation Standards (Science)

### The Practice of Science

- SC.K.N.1.1 Collaborate with a partner to collect information.
- SC.1.N.1.4 Ask “how do you know?” in appropriate situations.
- SC.2.N.1.2 Compare the observations made by different groups using the same tools.
- SC.2.N.1.3 Ask “how do you know?” in appropriate situations and attempt reasonable answers when asked the same question by others.
- SC.2.N.1.5 Distinguish between empirical observation (what you see, hear, feel, smell or taste) and ideas or inferences (what you think).
- SC.3.N.1.6 Infer based on observation.
- SC.4.N.1.7 Recognize and explain that scientists base their explanations on evidence.
- SC.5.N.1.6 Recognize and explain the difference between personal opinion/ interpretation and verified observation.
- SC.6.N.1.3 Explain the difference between an experiment and other types of scientific investigation, and explain the relative benefits and limitations of each.
- SC.6.N.1.5 Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.
- SC.7.N.1.6 Explain that empirical evidence is the cumulative body of observations of a natural phenomenon on which scientific explanations are based.
- SC.912.N.1.4 Identify sources of information and assess their reliability according to the strict standards of scientific investigation.
- SC.912.N.1.6 Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.

### The Characteristics of Scientific Knowledge

- SC.5.N.2.1 Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence. (Also assesses SC.3.N.1.7, SC.4.N.1.3, SC.4.N.1.7, SC.5.N.1.5, and SC.5.N.1.6.)
- SC.6.N.2.1 Distinguish science from other activities involving thought.
- SC.6.N.2.3 Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests and goals.
- SC.7.N.2.1 Identify an instance from the history of science in which scientific knowledge has changed when new evidence or new interpretations are encountered.

### The Role of Theories, Laws, Hypotheses, and Models

- SC.3.N.3.2: Recognize that scientists use models to help understand and explain how things work.
- SC.3.N.3.3: Recognize that all models are approximations of natural phenomena; as such, they do not perfectly account for all observations.
- SC.4.N.3.1: Explain that models can be three-dimensional, two-dimensional, an explanation in your mind or a computer model.



## Earth Structures

- SC.6.E.6.1 Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests and goals.
- SC.4.E.6.3 Recognize that humans need resources found on Earth and that these are either renewable or nonrenewable.
- SC.4.E.6.5 Investigate how technology and tools help to extend the ability of humans to observe very small things and very large things.
- SC.7.E.6.6 Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, and changing the flow of water.

## Earth Systems and Patterns

- SC.2.E.7.1 Compare and describe changing patterns in nature that repeat themselves, such as weather conditions including temperature and precipitation.
- SC.6.E.7.7 Investigate how natural disasters have affected human life in Florida.

## Interdependence

- SC.1.L.17.1 Through observation, recognize that all plants and animals, including humans, need the basic necessities of air, water, food and space.
- SC.4.L.17.4 Recognize ways plants and animals, including humans, can impact the environment.
- SC.7.L.17.3 Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation and nesting sites.
- SC.912.L.17.11 Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife and forests.
- SC.912.L.17.20 Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.

# Background Information

What is a dugout? Among the oldest forms of watercraft, a dugout is a canoe hollowed out from a tree trunk. People from all over the world made dugouts. They were widely used in North and South America before the arrival of Europeans for activities like transportation, hunting and fishing, as well as ceremonies and wars. In many places they are still made and used today.

## Archaeological Dugouts

Ancient dugout canoes are hard to find and not always documented. As of 2010, archaeological sources report that approximately 788 dugout canoes have been recorded in the United States and Canada. This number has increased since and continues to increase with new finds. There are reports of ancient dugouts in Latin America, but data is scarce for this region and there are no centralized records.

The oldest-known dugouts in North America date to 6,000-7,000 years ago and were found in Florida. People likely used dugouts earlier, but these have decayed or remain undiscovered.

## Dugout Canoes Found At Newnans Lake

In 2000, drought revealed 101 partial and whole dugouts in Newnans Lake, Florida. Local residents and high school students first spotted long, straight wood pieces in the dried lakebed. They called archaeologists, who identified the canoes and began excavations.

Archaeologists measured and sampled the canoes to learn more. Some of the data tell us:

- Canoe ages ranged widely—from 500 to over 5,000 years ago
- No canoes dated between 1,400 and 2,300 years old
- Most canoes were made from pine, a few were cypress
- 19 canoes had thwarts (partitions)

## Why so many canoes?

Scientists don't know why there were more than 100 canoes at Newnans Lake. Over 5,000 years, canoes could have accumulated for many reasons:

- Wind Drift: Did wind move canoes to this shoreline, landing them closer together?
- Preservation: Were preservation conditions ideal to preserve more canoes than average?





- Canoe “Junkyard”: Did people retire old, un-usable canoes here?
- Ancient “Shipyard”: Did people build canoes here using nearby resources—water, pine trees and stone for tools?
- Boggy Storage: Did people submerge canoes when not in use to protect the wood?

The Newnans Lake canoes may have been associated with village sites located across the lake. Some artifacts associated with the village sites suggest that the area was occupied intermittently by Native Americans from around 3,000 years ago up until at least 1,000 years ago.

### **How old are Newnans Lake dugouts?**

Of the 101 canoes discovered in the bottom of Newnans Lake, archaeologists documented and obtained radiocarbon dates for 55 of them. Radiocarbon dating revealed that the canoes range in age from 500 to over 5,000 years old. Over 70% of the radiocarbon dated canoes are between 2300 and 5200 years old. These dugouts date roughly to the middle through Late Archaic period (ca. 2,500-5,000 B.P.), an archaeological period characterized by a distinctive fiber-tempered pottery and hunting-fishing-gathering way of life. The remaining documented canoes fall between 500 and 1,400 years old, when material culture trends and lifeways changed. Why is there an almost 1,000 year gap (1,400 to 2,300 B.P.) in canoes is unexplained, but may indicate that there was little to no habitation near Newnans Lake during that time, that the lake was not navigable due to lower sea levels, or that another dry period occurred.

The broad range of dates for the canoes demonstrates that a wonderfully long tradition of canoe manufacture and use extended from minimally 5,000 years ago to the present. Florida’s rich wetland environments offered opportunities for collecting food and other supplies, transportation and trade. The canoe was especially important for Native Americans in many parts of North America, because the continent had neither wheeled vehicles nor draft animals prior to European contact.

### **How were the dugouts made?**

Careful excavation of the canoes revealed interesting similarities and differences. The Newnans Lake canoes are similar in shape and construction to other prehistoric canoes known from Florida. Most canoes were hewn from pine trees, common in the upland forests near the lake. Some were made from bald cypress surrounding the shore. All of the canoes were made of fire-hollowed logs, as evidenced by their partially charred interior. Although no distinctive tool marks were observed on any of the degraded Newnans canoes, both stone and shell implements probably were used to help chop down and shape the trees into dugouts. The boat-makers burned out the interior of a log and then chipped and gouged away the remaining wood and bark with adzes. Construction techniques like these were observed when European explorers arrived in the 16th century.





## Bows, Sterns and Thwarts

Bow (front end) and stern (back end) portions of dugouts are the most dense and best preserved. In general ends are blunt or slightly rounded, though several have upward-sloping and even distinctive overhanging platforms. Gunwales (sides) are often deteriorated. An interesting feature found in many of the Newnans Lake canoes is a “thwart” or bulkhead, which is a low partition creating sections within the boat and located in the middle and/or at the end. While noted occasionally in other Florida dugouts, 19 of the Newnans Lake canoes exhibited thwarts. The purpose of these is speculative—some suggest that the wider end thwarts may have been used as foot mounts to aid in poling through shallow grassy waterways. Other researchers suggest that the thwarts may be relicts of manufacturing to prevent the wood from warping. The sizes of the canoes at Newnans Lake range considerably, with the shortest at 4.57 meters (15 feet) and the longest at more than 9.5 meters (31 feet).

## Dugout Science

### Wood identification

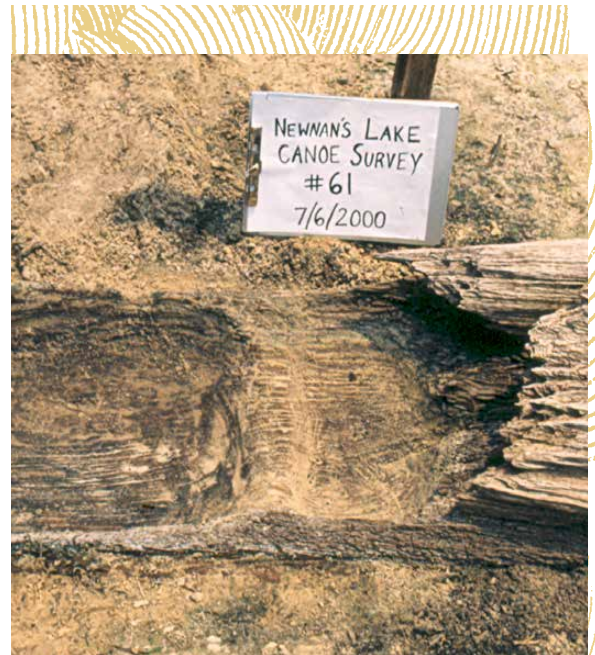
Using small thin sections of wood and microscopes, scientists can identify anatomically the type of tree used to make the dugouts. This helps researchers answer many questions about canoe practices and ancient landscapes. It can even provide clues about past climates.

### Dugout dating

Carbon dating is a method of measuring the age of an object that contains carbon. Scientists date canoes and other ancient wood by measuring carbon-14, a radioactive type of carbon atom. Every living organism has carbon-14, which naturally decays at a steady rate, allowing researchers to roughly determine its age.

When evaluating a site, an archaeologist may use both relative and absolute dating techniques to determine the age of an artifact(s), which aids them in assessing how old a site is and if there were one or more occupations at a site through time. Absolute dating determines a more exact date of how old a specific object is, whereas relative dating is an estimation based on the cultural assemblage and other factors of a given site.

Relative dating is an archaeological dating technique that determines the relative order of past events, without necessarily determining their absolute age. It assigns a speculative date to an artifact based upon many factors such as location, type, similarity, geology and association. Relative dating techniques are directly concerned with discovering the correct order of events at a site, and rely heavily on associations. Relative dating





usually relies upon several standard factors within a site.

Absolute dating provides a numerical age for the material tested, while relative dating can only provide a sequence of age. Absolute dating is usually based on the physical or chemical properties of the materials of artifacts, buildings or other items that have been modified by humans. Absolute dates do not necessarily tell us when a particular cultural event happened. But when taken as part of the overall archaeological record, they are invaluable in constructing a more specific sequence of events.

### **Saving old canoes**

Waterlogged wood decays when exposed to air—microbes move in, cells dry out and the wood can crack, shrink or warp. If the water is allowed to evaporate, the cell walls can shrink, causing loss of dimension in all planes. Waterlogged wood is degraded and soft, and vulnerable to physical damage. The aims of conservation, therefore, are to maintain the dimensions of the wood and replace the water with chemicals to consolidate what remains.

### **Other Canoe Evidence**

Sometimes other evidence suggests canoe use, even if the canoes themselves did not survive. These can include:

- Letters and journals from explorers who describe native peoples in Americas using canoes
- Native art depicting canoes
- The presence of canals suggesting that people traveled by water
- Woodworking tools such as a shell adzes and axes
- Woodchips
- Fishing net fragments
- Wooden paddles
- Shell anchors
- Long distance trade items
- Model/toy canoes

### **Travel and Trade**

In the ancient world, canoes allowed people to travel further and faster.

### **How far did ancient people travel?**

Archaeologists find non-local goods in sites throughout the Americas, sometimes hundreds or even thousands of miles from their source. We don't know exactly how they got there.



These goods may have traveled by canoe or other means with one group or passed through many hands along the way.

Canoeists are depicted on the displayed shell engraving found in Oklahoma, ca.1400. Gulf coast shell was an important trade commodity, found as far away as the Dakotas. The claw effigy on display was excavated in Ohio, but is made from mica found in North Carolina.

### Ancient politics by canoe

People have long used canoes for political reasons as well as daily life. Some traveled by canoe to pay taxes and tribute. Others traveled to distant areas for social or political events. With them, exotic goods and even ideas spread.

### Sacred and Social

In some cultures, canoes have been so vital that they have taken on sacred meaning.

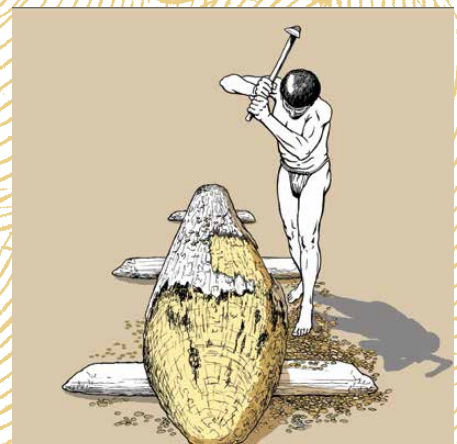
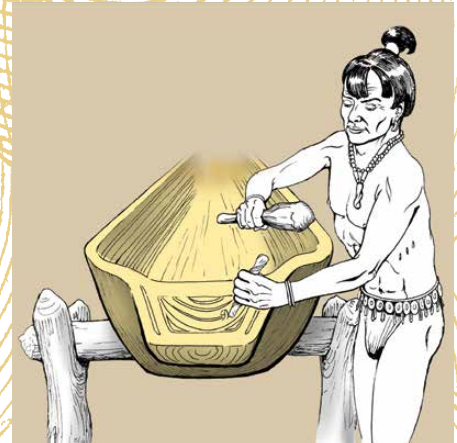
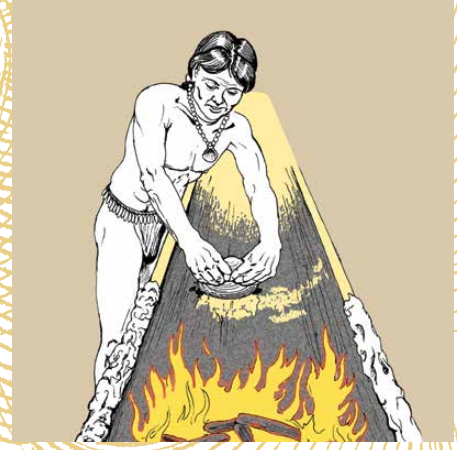
- Maya: The Mayan rain god, Chac, often appears paddling a canoe. The symbols represent food as offerings to Chac or gifts from Chac.
- Yudja: Yudja women of the Brazilian Amazon make a ceremonial beverage in a canoe built especially for this purpose.
- Suquamish: *"The canoe is the mother of everybody in that canoe, it's a female spirit, and it protects everybody in that canoe. And if you show disrespect by drinking or taking drugs, or even smoking... it's really disrespectful to the canoe and to yourself."*—Cassandra George, Suquamish, Tribal Canoe Journey, 2009
- Hawai'i: Native Hawai'ian canoe carvers pray to the god Ku.

### Ancient Canoe Making

Traditionally, people used fire and tools to fell trees and shape dugouts.

#### General steps

1. Fell tree: Use fire and axes to chop down tree.
2. Debark: Remove the bark with an adze—a tool used for chipping away small pieces of wood.
3. Hollow: Control fire with mud and water to soften wood for removal with adzes and gouges.
4. Sculpt: Use finishing tools (made of wood, shell, stone) to smooth and shape canoe and create other details.





**How do we know?** Historic documents and archaeology help us understand ancient technology. Much of what we know about Native American dugout canoes is based on a few ethno-historic sources. The first, published in the late 1500s, is a series of woodcuts by Theodor de Bry. De Bry illustrated Hans Staden's story of his shipwreck during a voyage to Brazil. The illustrations remain some of the most important early images of Native Americans, and include illustrations of canoes.

## Tools

Ancient coastal peoples usually used shell tools, while inland groups living along and near rivers and lakes often used stone. After European contact, metal tools typically took the place of both. The artifacts in this case are divided into three groups: axes (for chopping), adzes (for scraping) and finishing tools (for refining).

## Modern Dugouts

### Cultural revival

Many native people in North America are reviving the canoe carving tradition. Some are evolving with new tools and ideas. Many canoe carvers now use chain saws and metal tools. The revival is strongest along the Pacific Northwest, but others are also embracing dugout traditions.

- In the Northwest, the annual Canoe Journey is a revival of long-practiced customs—traveling by sea for important ceremonial occasions.
- In the Northeast, the Wampanoag, like other eastern cultures, are rediscovering how to make and use dugout canoes and revive water traveling customs.
- In the Southeast, 20th century tourism brought new life to Seminole dugout arts.

### Old ways thrive

Many native people in Central and South America still use dugouts in their daily lives.

The Vancouver Island canoe on display is an example of modern dugout traditions. George Taylor (Kwakwaka'wakw) commissioned Fred Peter (Nuu-chah-nulth) to carve this canoe about 40 years ago as a gift for Taylor's father. The design represents Kulus, younger brother of Thunderbird and the Taylor family crest. The front is Kulus' head and wing, the back is the tail.



## Modern Paddles

Paddle shapes often differ depending on local customs and environments.

- Pointed paddles slice smoothly through water, limiting sound and motion, making it easier to stalk prey.
- Wide paddles move lots of water and can increase speed.
- Double-ended paddles help rowers move quickly and efficiently.
- Poles and forked prongs are used to move canoes through shallow waters and grassy wetlands.

