

# A Good Boat is Hard To Find

Guess we need to build one

Ecology of Isle Royal  
June 2006

8th Grade woodworking  
Ring Lardner Middle School  
Niles Michigan

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## Over view

This will be thematic units of instructional as component of an industrial arts curriculum for middle school students. The broad goals of the program are to use their interests in woodworking and more specifically boat building as an application of science, social studies, mathematics and technology education.

The program will revolve around a study of the Isle Royale and Lake Superior region and the transportation needs of the residents from aboriginal peoples through the fishing communities and today's national park visitors.

Students will study and experience activities related to the history of Isle Royale and primarily the role of water transportation in its settlement and resource extractions.

The project will culminate with class construction of a sea kayak appropriate for today's visitor activities on Isle Royale.

This unit is appropriate for our local community which is located on the St. Joseph River within paddle distance of Lake Michigan. There is a significant maritime heritage of the community from the French Voyagers through modern marine transport and water recreational activities.

## Objectives

Students will be able to identify major features of the Lake Superior drainage basin and the role in Michigan settlement and current economic and recreational activities.

Students will demonstrate a knowledge of the importance of water transportation in the Great Lakes Region.

Students will be able to identify different types of watercraft, parts and their intended uses in historical and current context.

Students will demonstrate a knowledge and appreciation of the role of Great Lakes and more specifically Isle Royale fisheries and the related ecosystem issues that contributed to fisheries cycles.

Students will be able to utilize math and measurement skills to construct wooden boat models from scale drawings.

Students will construct as a group a safe efficient paddle powered watercraft capable of a Great Lakes paddle trip.

## Application Details

Designed to be utilized in an 8<sup>th</sup> grade Industrial Education woodworking program.

A typical school woodworking laboratory with adequate open floor space for 16' long boats and bench space for up to 30 students to construct models in teams of two.

A competent, certified instructor in the woodworking disciplines to safely manage and instruct students in the use of hand and power woodworking equipment.

## Materials list

Lake Superior maps

Great Lakes region map

Isle Royale maps

Fish and exotic species images

Lake trout, white fish, smelt sea lamprey, other current aquatic exotics.

Copper ore sample, copper products

Boat pictures and silhouettes

Model boat plans for a skiff and canoe.

Measured drawings/ plans for a decked sea kayak (see bibliography)

Basic hand wood working tools including planes.

Power tools, table saw, scroll saws, band saw, random orbit sanders, electric hand drills,

Measurement tools, metric and English measure.

1/8" luan plywood for models

4mm marine plywood for sea kayaks

Marine adhesives, caulk guns

Epoxy/ fiberglass materials and safety equipment

Acrylic paints for models, Oil base paints and varnish for sea kayak

Safety glasses, disposable gloves,

## Background

Isle Royale by its very nature as a fairly remote island community is well connected to maritime transportation. The earliest visitors could cross the ice from today's Minnesota but from earliest copper mining today's national park visitors boats are essential. The opening of the Erie Canal in 1825 and the 1855 state locks on the St. Mary's river opened Michigan and the Lake Superior region up to European and eastern US settlers.

Isle Royale already had a history of copper production on a limited scale from the native Americans but it was the fishing communities that truly developed the boating history of the island. Isle Royale with its numerous natural harbors and rich fishing grounds developed a series of seasonal and year round communities based entirely on boats as a form of transportation and communication. Initially the boats were sail then the large steamers for transportation to Canada, Minnesota and Michigan and eventually the gasoline and diesel boats of the fisherman and recreational users. The history of the island and Lake Superior really cannot ignore the importance of water borne transportation.

As Isle Royale has become a national park the fishing communities have declined often forcibly by the park service and recreational uses have furthered the boating tradition. Today the Island is served only by boat and seaplane. All travel except walking is provided by boat. Again Isle Royale's wonderful natural harbors provide great recreational boating activities. The Island is served daily in season by large ferries from the Keweenaw peninsula in Michigan and Grand Portage, Minnesota. Private sail and power boats visit from all around the Lake Superior region and the island hosts some of the most protected but remote and beautiful fresh water canoeing and sea kayaking in the world. The fishing has improved over the most recent decades and recreational fishing thrives in its waters.

The selection of a sea kayak as a culminating activity for this unit of study is appropriate for Great Lakes communities. Of all the human and sail powered vessels it is the most logical for a lake and open water environment. The history of the boats is from the northern aboriginal cultures where the boats were used for hunting vessels in cold arctic waters. The paddlers can be protected from rough waters and have a quick maneuverable craft capable of carrying a moderate load. For today's use sea type kayaks are fitted with water tight compartments that make them practically unsinkable. Modern spray skirts keep out waves and heat in the boat and the long waterline provides straight tracking with a minimum of effort. They can carry loads in water tight compartments for extended paddling trips and are light enough to be portaged overland safely. These are not to be confused with smaller recreational kayaks that are designed for initial stability and ease of entry. These boats do not track well and do not provide the storage and speed needed in an expedition style sea kayak. Sea Kayaks are not suitable for fast moving rocky rivers but excel in the near shore great lakes environment..

Before embarking on this unit the following references are highly recommended. A more detailed bibliography is available later in this plan.

The Kayak Shop: Three Elegant Wooden Kayaks Anyone Can Build by Chris Kulczycki  
Detailed building instruction on marine plywood kayaks

Community boat building manual from Wooden Boat magazine  
A reference to building boats and developing community with large groups.

Building the Six Hour Canoe  
by Richard Butz, John Montague (Illustrator), William Bartoo  
Probably the simplest and least expensive to build wooden boat plan available. Very good intro to boatbuilding.

A Good Boat Speaks for Itself: Isle Royale Fishermen and Their Boats  
by Timothy Cochrane, Hawk Tolson  
A more specific look at Isle Royale fishing communities and the boats used in the fishery

Paddle-to-the-Sea by Holling C. Holling  
Required reading for many Michigan elementary students, A trip through the lakes of a hand carved model of an Indian boy in a canoe. Timeless Great Lakes story.

Superior Wilderness: Isle Royale National Park by Napier Shelton  
A series of essays on the natural and human history of the island. Easy read, quite informative.

<http://www.guillemot-kayaks.com/> Gullimot Kayaks wood kayaks. Building tips, trip reports, techniques. Good pictures, links

<http://www.clcboats.com/> Chesapeake Light Craft, Web sight, builders forums  
One of several sellers of wood kayak kits, plans and supplies, very detailed web site with building details, ideas and many pictures of other home built boats.

## Methodology

This activity will be broken into three units

The Isle Royale, Lake Superior and its place in Michigan and US History.

The importance of a good boat to fishing, exploration and recreation

Building a vessel to explore Isle Royale National park.

### Unit 1 A Sense of Place

Time 3-5 days

#### Geography

Display maps of North America, Great lakes Region, Michigan, Lake Superior and Isle Royale in sequence.

Use Map Quest, and Google Maps zoom features and LCD projector if available

Have students identify key locations and transportation routes as you cycle through the maps.

- Lakes Ontario, Erie, St Clair, Huron Michigan and Superior
- Isle Royale, Keweenaw peninsula, Apostle Islands, Georgian Bay, Saginaw Bay, Pictured Rocks, Sleeping Bear Lakeshore, Manitou Island, Lake Nipigon.
- St. Lawrence seaway/river, Niagara Falls, St. Mary's river, Erie Canal, Welland Canal, Sault locks,
- New York, Albany, Buffalo, Cleveland, Detroit, Saginaw, Chicago, Mackinaw City, Duluth, Marquette, Thunder Bay, Sault Ste. Marie, Copper Harbor, Houghton/Hancock, Grand Portage.

Hand out laminated Lake Superior Circle tour maps

Have students determine the Length and width of Lake Superior using rulers and the scale of miles and kilometers.

Determine the size of Isle Royale and the distances from Rock Harbor to Copper Harbor and Sault Ste. Marie.

Using Map software determine the driving distance and time from the school to Copper Harbor and Grand Portage.

Check the travel time to Isle Royale from ports for the three scheduled ferries.

Have students complete the attached Geography worksheet.

#### Exploring Isle Royale

1. Post a large map of the island and review the major points and locations. (Rock Harbor, Chippewa Harbor, Windigo, McCargo Cove, lighthouses, Siskiwit bay and lake, Greenstone ridge, sea plane base and any other sites of interest)
2. Move to computer lab and direct students to the NPS web site for Isle Royale. Have students explore the site and follow other links from web searches. Hint: closely monitor students open searching, Have goals. Examples include specific activities, references, specific information
3. Have students write a one page answer to one of the following questions.

- a. I plan to travel from Windigo to the Rock Harbor lodge. How will I travel, what may I see along the way?
- b. How can I convince my mom that it is a great idea for me to explore Isle Royale?
- c. If I attended school at a school on Isle Royale in 1922, what would I do for fun?

Wrap up discussion

Discuss the following briefly

Reference Superior Wilderness and personal experiences.

1. Why is Isle Royale in the US
2. Just how far did native copper travel?
3. What other activities took place on the island? Logging, fishing, mining, recreation
4. Why did the fishing decline? Political, economic and biological
5. What is Isle Royale like today?
6. Share a few anecdotes, wolf-moose, McCargoe cove, shipwrecks, greenstones etc.
7. The big question for this activity. WHY BOATS?

## Unit 2

### A good boat

### 3-5 days

Bring four boats to school. Ask parents or a local vendor to help.

A small sail boat, a canoe, a sea kayak and a row boat. Models are acceptable if space or storage is a problem.

Review the parts of each boat. Use hand out of terms

Discuss the specific intended use of each, advantages and disadvantages,

If there is access to a school pond or other water source use the non sail craft in class. (Parent permission and full water safety rules required)

Have students share some of their own boating experiences.

Quickly move beyond the typical student reason to go canoeing as a reason to swamp the boat and dump their buddies out. The role of a boat is to keep you on, not in the water.

#### **Model boat building.**

Divide the class into teams of two students.

Students will build a model of a flat bottomed canoe or a wide skiff in class.

Use the Six Hour Canoe plan at 1" = 1' for the canoe

We have a set of patterns for a skiff 22" long that will be drawn up and available for distribution after October of 2006.

Specific materials and tools used

1/8" plywood, white pine strips

Scroll or band saws

PL premium polyurethane adhesive

Rulers and squares

Titebond II or III wood glue

Clothes pins

Masking tape

Latex gloves

Sandpaper 60, 100, 150 grit

block plane

Acrylic paints

If pre-cutting kits in volume

Table saw, band saw, belt sander. Kits can be cut in stacks of 10 or more at a time on a band saw.

Assumption here is that this is a second level woodworking class. Students have experience with scroll saws and hand tools. They know basic gluing techniques and can read a scale drawing.

Give each student an 11 x 17 copy of the plans for the boat to be constructed.

Discuss scale and measurement and if needed back up and re-teach the measurement and layout concepts required. This will vary greatly depending on previous experience.

Another possibility is to provide pre cut parts or patterns.

Demonstrate the process with models pre assembled at various stages of construction to keep the process moving while glue dries. Have a completed model available for students to view. It really helps.

Use a modified Stitch and glue technique that is discussed at the CLC web site.

Instead of stitching have the students tape the hull joints together with masking tape from the outside.

Tape the sides and transoms only on day one and then glue the seams from the inside with wood glue or a polyurethane adhesive. The bottom will be fitted the next day and also taped and glued in place.

The glue should fill any voids and can be pressed into small gaps with a gloved finger.

When the glue is dry have students remove the tape and sand all the rough edges, soften the bow, stern and chines and apply the gunnels. These can be strips of clear pine ¼” x 1/8” and held in place with clothes pins or tape while the glue dries overnight. Use white or yellow glue for this step.

When the boats are completely sanded have the students paint the boats in and out with a glossy exterior latex or acrylic paint. Enamels work better but are very difficult to clean. Names can be applied to the bottom of the hull.

**Evaluation** of the boats is important to maintain quality, Individuality in paint jobs is fine at home but these boats will be seen by many adults in the community and may be entered in regional woodworking competitions. This is not the place for a sloppy kid paint job. Craftsmanship and final finish are very important.

A simple Rubric is helpful.

1. Paint job is smooth and consistent, one color inside and one color outside. 10 pts
2. All corners are rounded and smooth, no leaks 5 pts
3. Boat is symmetrical and not obviously misshapen 5 pts
4. Gunnel are flush with top edge and fit without gaps. 5 pts
5. Overall boat conforms to plan. 5 pts

#### **Are these boats good, will they carry a load?**

When the boats are complete the real evaluation is in the water

1. Fill a kiddies pool with water outside or on a shop floor with a drain.
2. Load test the boats with gravel or science department mass units.
3. Demonstrate the effects of unequal loading
4. Re load the boats to 75% of capacity to submerge a gunnel and add waves to the pool by dropping a basket ball from a standard height into the pool.
5. Have students determine the effects of waves on capacity.
6. Some students can experiment with transom slope to show the effects of a following wave on capacity.
7. Discuss and demonstrate displacement.
  - a. submerge a boat in water and weigh the water the boat will hold.
  - b. Compare the weight of water vs. the weight of load the boat carried in calm water, the weights should be very similar.
  - c. Ask students can a wood only boat sink? Why does a steel boat float?
  - d. Why are air chambers typically high in a boat and engines very low?
  - e. What is a self righting boat? Who would use this type of boat?
8. Discuss effects of loads on boats such as motors, sails, cargo and passengers.
9. Discuss the effects of a weighted keel used in sailboats.
10. Specific to Isle Royale what characteristics do you want in a fishing boat for use in the near shore waters?
11. What characteristics do you want in a boat to get back to Houghton or Grand Portage?
12. Why should you wear a PFD even if you are a strong swimmer?

## Unit 3

### Exploring Isle Royale by boat today Building a marine plywood kayak.

Ongoing activity concurrent with other instruction. Minimum 4 weeks

A good read for the instructor,

Two trip reports

The Eye of the Wolf by Carl Strang, <http://members.aol.com/wildlifer/isleroyl.htm>,

Wes Boyd's Kayak Place <http://members.aol.com/wildlifer/isleroyl.htm>,

Read The Kayak Shop, experiment with epoxy and fiberglass on one of the model boats from class and then read The Kayak Shop again.

Building a fine wooden boat with middle school students is a bit like herding chickens. Keeping everyone attentive and headed in the same direction can be challenging.

All the safety rules of the shop need to be in full force, attention to quality is critical as someone's life may depend on the work and the paying customer will almost certainly be an adult. You need to build an adult boat in appearance and size. Most people are reluctant to spend a great deal of money on an item their child will quickly out grow. We also build simple marine plywood canoes that are a much better choice if the actual client is the students in the class. Building cost of a true sea kayak with the necessary hatches, lines, seats and blocks will be around \$1000.00. We regularly make epoxy sealed but not fiber glassed marine plywood canoes for under \$200.00. But I wouldn't even consider them for use on the great lakes.

We have had great results building boats on a small group basis. A few students work on the boat while others complete their own projects in the shop. Keeping 30 students occupied on one long term project is an invitation to disaster. We explain the process and do demonstrations to the entire class but the actual work is done by a small group.

Typically the major epoxy and fiberglass jobs are done after school when only highly interested and safety conscious students are invited. They become the teachers for other students.

I also like kayaks in the shop because they are narrow and light and are easily placed on a high shelf away from damage potential when not in construction. With stitch and glue technique you do not need a heavy form or permanent storage locations for large construction jigs.

We sell most of our boats either to student's families for the cost of construction including shop rate or on the open market by a prearranged commission. I am adamant about quality with boats to be sold. It teaches the students the importance of craftsmanship and patience. We have other projects for students that just want it done.

This plan will specifically not reference technique. There are many excellent references available and when you purchase plans a construction guide will typically be included.

The following notes are for teachers with techniques specific to a school setting.

1. Choose a relatively simple design with a hard chine, Much easier to form.
2. Use Okume plywood, it costs more but is worth it for sanding and planing.
3. With students measure 8 times for every cut. This plywood costs \$50.00 a sheet.
4. Plastic zip ties are safer with students than copper wire, tape is also useful but no duct tape. It will tear plywood and leave a residue.
5. Use bodo to fill screw holes, thickened epoxy is expensive and not needed.
6. for the long glue joints deck to hull use a marine adhesive instead of thickened epoxy. It's much easier to manage.
7. Students can easily sand through surface veneers on plywood, no power sanders to the inexperienced, Use finer grit sand paper.
8. Plane edges instead of sanding if possible. Much easier to clean and no dust.
9. Always, always, always wear long sleeves and gloves when using epoxy, wear throw away clothes, it absolutely does not come off.
10. Do not sand green epoxy ever. Do not let the students sand green epoxy. We scrape fresh epoxy to smooth with cabinet scrapers. No dust at all.
11. Don't be tempted to use normal epoxy fillers for building up surfaces. Use the fairing fillers. They are lighter and much easier to form.
12. Use slower setting epoxy hardeners, they blush less and smooth easier.
13. Never sand through the fiber glass to smooth a surface, build it up, I have seen students sand completely through the glass thus removing all reinforcement strength to the plywood
14. Make sure the custodian knows what you are doing, We have had the heat turned off, finger prints in fresh surfaces, dust from sweeping in finishes, you name it we have seen it. Tell your building principal too. Invite them in to see the progress.
15. Take many, many pictures.
16. Strongly consider a painted hull, clear finishes with students are not easy, Paint can cover many mistakes.

When the boat is complete if at all possible have students use the boat even if at a local indoor pool in the middle of winter. Invite the newspaper. Show the boat at the county fair, display in the hallway at band concerts and parent teacher conferences. Have the kids show it off. If they scratch the paint, fix it. Boats will generate great enthusiasm for an industrial arts program. But they must be seen.

## Extensions

Isle Royal an provide an excellent thematic base of study. Our unit touches on all of these to some extent. Further study is very possible.

- Michigan history  
Settlement, statehood, immigrants, Sault locks, Kewenaw copper, fishing industry
- Mathematics  
Measurement, volume, area, ratios and proportion, shapes, angles
- Earth and Physical science

Density, displacement, buoyancy, exothermic reactions, adhesives, solvents and solutes, Geology, mineralogy, climate, weather,

- Ecological sciences

Predator prey relationships, islands and evolution, niche, exotic species, forestry, fisheries,

- Technology education

Internet resources, navigation, transportation, computer aided design, Global Positioning systems (GPS) Global information system (GIS)

## Parts of a Boat

**Hull:** The boat itself. The hull keeps the water out

**Cockpit:** The "hole" where the crew sits.

**Transom:** The (usually) flat vertical part at the stern of the boat. The rudder or outboard motor is attached to the transom on most boats

**Bow:** The front end of the boat.

**Chine:** The turn of the bilge, Where the sides meet the bottom of the hull.

**Stern:** The back end of the boat.

**Starboard:** Looking forward, the right side of the boat.

**Port:** Looking forward, the left side of the boat.

**Gunnels:** The thickened rails on the edge of an open boat, also called the rails.

**Mast:** That big stick standing vertically. .

**Forestay:** For a mast standing alone to have adequate strength, it would need to be heavy. Much better to have a light mast with supports. Some sailboats have wire ropes (usually) from the top of the mast to the bow. This is a forestay.

**Shrouds:** Same as a forestay, except to the port and starboard, and slightly aft of the the mast

**Boom:** The horizontal spar to which the sail is connected. The boom is used to maintain the sail shape. The boom is attached to the mast close to the base of the mast and pivots about the mast depending on **point of sail**.

**Jib:** A forward sail on some boats, the jib is attached to the *forestay*.

**Mainsail:** The main sail of a boat. *Usually* the biggest sail on a boat

**Halyard:** The rope used to raise the mainsail; attached to the head corner and runs down the mast.

**Mainsheet:** A rope from the end of the boom. The mainsheet controls the mainsail position

**Rudder:** The rudder is used to steer the boat. Attached to the *transom* on dinghies. On most small boats the rudder can be raised to allow easier launching

**Tiller:** Use this to control the rudder. It's the handle.

**Keel:** lower rib on bottom of the hull. Adds strength and helps tracking, essential on sail boats.

Using the Lake Superior Circle tour Map Complete the following.

1. Map scale in miles per inch \_\_\_\_\_
2. Map scale in kilometers per centimeter \_\_\_\_\_
3. Approximate length E-W of Lake Superior. Kilometers \_\_\_\_\_ Miles \_\_\_\_\_
4. Approximate width of lake N-S Kilometers \_\_\_\_\_ Miles \_\_\_\_\_
5. Distance to drive around lake Superior Kilometers \_\_\_\_\_ Miles \_\_\_\_\_
6. Approximate driving time at Average speed of 50 MPH \_\_\_\_\_
7. Driving time at 65 KPH \_\_\_\_\_
8. Nautical distance from Copper Harbor to Rock Harbor \_\_\_\_\_
9. Travel time at 18 MPH \_\_\_\_\_
10. Nautical distance from Sault Ste. Marie to Rock Harbor \_\_\_\_\_
11. Travel time at 30 KPH \_\_\_\_\_

Using the internet

1. What is the mileage from our school to Copper Harbor? \_\_\_\_\_
2. What is the approximate driving time? \_\_\_\_\_
3. How much fuel will we use at 20 MPG? \_\_\_\_\_
4. Name three commercial boats that service Isle Royale, the travel time, home port, and round trip cost.

Boat	Crossing time	Port	RT Cost
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

5. How big is Isle Royale? Length \_\_\_\_\_ miles Width \_\_\_\_\_ miles
6. In a kayak at 4 mph. How long to paddle from Rock Harbor to Windigo? \_\_\_\_\_

Specific Michigan benchmarks addressed in this unit.

## Social Studies

### **Content standard # 2 Historical Perspective**

Middle School

1. Use narratives and graphic data to describe the settings of significant events that shaped the development of Michigan as a state and the United States as a nation during the eras prior to Reconstruction.

## Science

### **Hydrosphere (EH) V.2**

Middle School

**All students will describe the characteristics of water and demonstrate where water is found on earth:**

1. Use maps of the earth to locate water in its various forms and describe conditions under which they exist.

**All students will describe how water moves:**

1. Identify and describe regional watersheds.

## Mathematics

Middle School

**Content Standard 2: Students identify locations of objects, identify location relative to other objects, and describe the effects of transformations (e.g., sliding, flipping, turning, enlarging, reducing) on an object. (Position)**

1. Locate and describe objects in terms of their position, including compass directions, Cartesian coordinates, latitude and longitude and midpoints.

2. Locate and describe objects in terms of their orientation, direction and relative position, including up, down, front, back, N- S- E- W, flipped, turned, translated; recognize symmetrical objects and identify their lines of symmetry.

5. Use concepts of position, direction and orientation to describe the physical world and to solve problems.

**Content Standard 3: Students compare attributes of two objects, or of one object with a standard (unit), and analyze situations to determine what measurement(s) should be made and to what level of precision. (Measurement)**

1. Select and use appropriate tools; measure objects using standard units in both the metric and common systems and measure angles in degrees.

2. Identify the attribute to be measured and select the appropriate unit of measurement for length, mass (weight), time, temperature, perimeter, area, volume and angle.

3. Estimate measures with a specified degree of accuracy and decide if an estimate or a measurement is "close enough."

4. Interpret measurements and recognize that two objects may have the same measurement on one attribute (e.g., area) but not necessarily on another (e.g., perimeter).

5. Explore scale drawings, models and maps and relate them to measurements of real objects.

6. Apply measurement to describe the real world and to solve problems.

Peripheral coverage is also applied to simple machines, geography concepts, biographies, transportation and marine principles.

## Bibliography

Annotations are referenced in text of lesson

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Specifically referenced Maps

Lake Superior Circle Tour Map, Lake Superior Magazine, Duluth MN,  
[www.lakesuperior.com](http://www.lakesuperior.com) or 1-888-244-5253

Exploring Isle Royale park service brochure, US National Park Service, [www.nps.gov/isro](http://www.nps.gov/isro)

Topographic Map of Isle Royale National Park, United States Geologic Survey