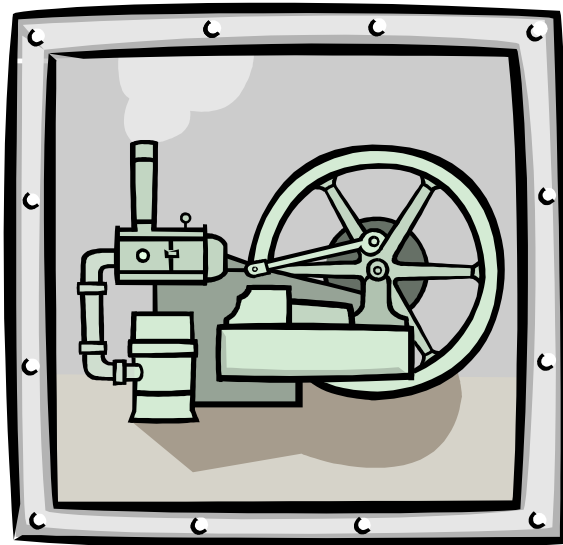
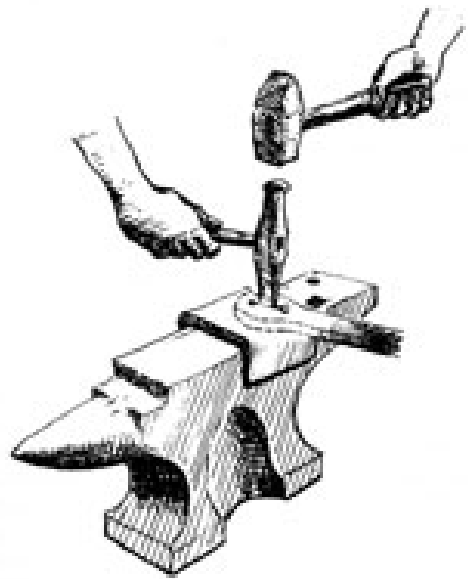


# Boat Building, Steam Power, and Rivet Toss



National Mississippi River Museum & Aquarium  
History Education Curriculum

**Target Grades:** 4<sup>th</sup> grade - high school

**Key Words:** Boat Building,  
Riveting

**Subject Areas:** History, Industrial  
Technology

**Duration:** 45 minutes - 1 hour

**Title:** *Boat Building, Steam Power, and Rivet Toss*

**Summary:**

Participants will tour the boat building shop at the National Mississippi River Museum & Aquarium to see wooden boat building demonstrations and blacksmithing demonstrations (not usually with a hot forge unless it is a more in depth program). Students will be able to handle and try their skill by working with several of the hand tools in the shop. They will also see a model steam engine operate and have a chance to test their skill at tossing rivets the way boat builders did prior to gas and arc welders.

**Objectives:**

To learn about the boat building industry along the Mississippi River, and about the various techniques employed to construct both large and small watercraft. Construction techniques for both wood and metal boats will be discussed.

**Group Size:** 10- 25 people

**Background for Educators:**

During most of human history boats, canoes, and other watercraft were made of wood, and usually of hand collected natural materials. Some people used bark or hides covering a wooden frame to construct watercraft. Eventually wooden planks were used for boat construction and eventually metals such as copper and steel were used on boat hulls. In the twentieth century fiberglass plastic also became a very important boat building material.

Birch bark canoes are built from white cedar wood, spruce or pine roots, and the bark of the birch tree. This canoe was the sealed at the seams with pine tar mixed with charcoal and animal fat to waterproof the canoe.

Prior to the use of electric welders, most steel hulled boats were built of steel plates joined by rivets. Tossing red hot metal rivets was a very important skill in assembling steel plates used in the boat building industry. One man would heat the rivet in a forge and then this hot rivet would have to instantly be removed from the forge fire and be hammered into place in holes joining the steel plates. To speed the process of getting the hot rivet to the riveter, the rivet was often tossed from the forge to the riveter who would catch this hot rivet in a metal cone. This hot rivet was then instantly fitted into the hole and the rivet fitter would hold the hot

rivet in place while someone on the other side of the steel plate would hammer the hot rivet to form a head to hold the rivet in place, before it cooled.

Steam power became the most important means of powering large boats until the development of the internal combustion engine that used petroleum based fuels such as gas and diesel. A model steam engine will be used to demonstrate the workings of a simple steam engine and show the students how power can be used from heated water.

## **National Mississippi River and Aquarium Boat Shop Information**

**Purpose of the boat shop:** to demonstrate boat building, historic artisan work, and the use of hand tools.

### **Boats displayed on top platform (from left as you are facing it):**

1. Scull boat – powered by a sculling oar which is one oar located on the back of the boat. Used for duck hunting; made of wood and canvas. People would hide down in the boat. They would use the sculling oar to propel the boat forward to sneak up on ducks and then stand up and shoot them. The people who did this were market hunters: people who hunted as much as they could to sell them to meat markets, before they had limits on the number of ducks that could be taken.
2. Bull boat --- made of buffalo hides and willow branches. Mandan Indians of North Dakota built bull boats when they hunted and killed buffaloes. They would take the hide and stretch it over a round willow frame (like a big basket) and let it dry in the sun. They would then use these boats to cross back and forth across the Missouri River. Sometimes they also used these boats to carry their dried buffalo meat across, after having hunted on the other side of the river. There is a paddle inside of it. Usually one person would paddle in the front, alternating from side to side to keep it going forward.
3. “Grumman Sport Boat” – made of aluminum; it was used on the upper Mississippi Fish and Wildlife Refuge for banding ducks and wildlife census in the 1960’s until about 1980.
4. Unfinished wood strip motor or fishing boat – never finished – older boat from an old boat shop.
5. Birch bark canoe built in about 1987 by Jack Minehart of cedar Falls, Iowa with help from museum staff.

### **Boats displayed on the ground floor:**

1. Big boat in the back is called a bateau – was used by loggers when putting together log rafts, in maneuvering log rafts down the river, and to travel from the log raft to the shore and back.
2. Row boat under construction – made of pine – called a “wet boat.” There are gaps in it when it is out of water. When it is put in water, the wood will swell. After the wood swells, it will stop any leaks.
3. A wood-strip frame that looks like half of a canoe – this is a bending form for canoe ribs that will be used to build canoes in the boat shop, such as birch bark or canvas-covered canoes. (The ribs will be steamed and then bent around this bending form.) The ribs and planking for birch bark canoes (some of which have already been made) are made from a white cedar log. The birch bark is the covering, with the inside of the bark on the outside of the canoe. The entire canoe is stitched together with roots from the black spruce tree, and all the materials come from the north woods (Minnesota, Wisconsin, Michigan and Canada). The hardest thing about building the canoe is harvesting the natural materials. A “tar” or “caulk” to seal the seams is made of pine pitch, animal fat and charcoal. Some or all of this “caulking” may need to be renewed a couple of times a year, depending upon the amount of usage of the canoe.
4. Plywood sailboat under construction, in corner of the boat shop.

### **Tools in the boat shop:**

As stated above, the purpose of the boat shop is to demonstrate boat building and the use of hand tools. We only have one electric grinding tool for sharpening the other tools.

1. Tools displayed on the east brick wall include:  
Saws and equipment used for logging on the right. On the left are tongs, hook, pike pole, and saws for ice harvesting.
2. Blacksmithing equipment:  
Forge and anvil that are used to make hardware for the log cabin on the museum grounds, for various tools, and for iron boat parts. The forge is a portable one so all blacksmithing is done outside (so wood chips from shaving don't catch on fire.)
3. Shaving bench – an important tool for making canoe ribs, spokes for wheels, new handles for tools, shingles. It is used with a draw knife or with a spoke shave. (If allowing kids to try something on the shaving bench, have them use the spoke shave as it is safer.)
4. Froe and wooden mallet – used to split log for shingles, or planking and ribs for canoes.
5. Tools used in building a birch bark canoe: froe and mallet for splitting logs; shaving bench and draw knife for making ribs and planking; steamer for bending ribs (this equipment will be set up just temporarily when needed); bone and steel awls for stitching canoe together.

### **Materials Needed:**

Hand tools in the boat building shop such as planes, draw knives, spoke shave, drills, forge, tongs, hammers, clamps, and measuring devices, aprons, safety goggles or glasses, model steam engine.

### **Setup:**

Prior to this session beginning the facilitator must open up all of the tool cases and entry gate, it is also important to get out the tools to be demonstrated and used by students, and make sure everything is set up for the steam engine (please refer to separate instructions below).

- Set out the rivet cup and tongs along with the wooden rivets
- clamp a board to be planed into the wood vise on the side of the workbench
- put a piece of wood to be shaved into the shaving bench for use with the spoke shave
- set up the brace and bit for students to try drilling into a wood scrap
- set out the three caulking chisels, oakum caulking fiber, wooden mallets, and caulking board on the work table
- set up and fill the steam engine with water, get out a fuel tablet to be lit for the demonstration
- set up the sailboat troughs and model sailboats

### **Procedure:**

- Boatyard Plaza

Meet the students outside of the boat shop and take them down the steps near the Logsdon to look at the wooden hull. Ask them if they think the Logsdon would float if it was to be launched into the water. Point out all of the cracks and gaps in the wooden hull and explain how the wood would swell if it were to be but into water. Further explain how important it was to pack caulking into the cracks so that when the wood did expand it would seal the leak. There may be old caulking rags hanging from the bottom side of the Logsdon. While the students are in the Boatyard Plaza some of the boat building machinery can be pointed out as well as the boat launch.

- Woodward

Lead the student group to the Woodward Museum wing, just outside of the boat shop to view the diorama of the Ice Harbor showing the Sprague being launched. Show them some of the objects from the Sprague. Take a tour through the Woodward to view various wooden boats.

As you pass the steamboat area, a mention of wooden hulled steamboats can be made. Look at the clamming boat and the Rosalie pleasure boat. Mention how these wooden hulled boats would have to be hand caulked and sealed between the wooden seams on almost an annual basis, and often had to be bailed or pumped out regularly.

Stop at the metal plate just outside of the boat shop and discuss how metal hulled boats were built before welders were used. Point out the rivets and the plate of steel covering and riveted over the metal seam. Explain that metal hulled boats, ships, and barges used to be put together from large metal plates that were overlapped and hot riveted together through pre-drilled or punched holes. The *Titanic* was constructed in this fashion.

- Boat Shop

Upon entering the boat shop point out the various boats displayed and being constructed in the shop. Demonstrate and interpret the boat building process for canoes, bull boat, wooden boats, and metal hulled boats.

Light the fuel in the steam engine and let it begin heating the boiler in a safe place. Remind the students that there is a flame in the engine and not to touch it while it is heating. Put the toy firemen next to the steam engine as a reminder.

Allow students to handle and use some of the hand tools on scrap logs or wood, being careful to point out the sharp blades and discuss safety issues. Show the students the method of using the shaving bench with spoke shave, wood plane at the workbench, brace and bit at the workbench or short table, caulking mallets and chisels, and rivet toss. Allow each student to rotate individually or in small groups so that they can try all of these stations.

Show how tools are cared for and sharpened.

Show the forge, metal rivet, and rivet cup to catch red hot rivets. Allow the students to try their hand at throwing and catching a “hot” rivet (made of wood). The throwing can either be with a blacksmith tongs or a leather glove (originally asbestos). The hot rivet can be caught in a metal rivet cup and picked out of the cup with a blacksmith tongs.

Note: During special or extended programs students may be able to make a small project at the boat shop, such as a small wooden sail boat, bird house kit, or wooden toy.

When the steam engine is ready to operate call the students together at the workbench and demonstrate the steam engine. After the demonstration put the steam engine back in a safe place and allow the students to continue their hands-on activities in the boat shop.

### **Steam Engine instructions:**

The model steam engine is made by Wilsco which is a German company. It actually operates by heating water in a small boiler to produce steam that can be used to turn a flywheel, operate a steam whistle, or power other model equipment. The fuel for the steam engine are called esbit tablets. One tablet should be sufficient for a short run of the engine, and two tablets will make the engine run for a fairly long time.

The steam engine should be set up and a fuel tablet made ready. It is very important to make sure all moving parts are oiled and that the water level in the boiler can be seen in the glass water level window. It is best to have the water level at least half way up on the window. If more water is required use distilled water if there is some available in the tool room.

When the students arrive in the boat shop, and after the initial explanation of the shop, the fuel tablet can be lit to heat the steam boiler. The steam engine is then put out of the way, in a safe place, until it is ready to run.

**Note:** The boat shop educator should be the only one to operate the steam engine as parts of it can be very hot and may cause a severe burn.

Additional equipment may be attached by pulley belts to the steam engine. Two possibilities are a man with a table saw that can be run by the steam, or a metal shear machine. Either one of these pieces of equipment may have been run by steam and later electricity in the Dubuque Boat and Boiler Works. Point out the large metal shears outside in the boatyard plaza that was used for cutting large metal plates for boat building.

The steam whistle should only be demonstrated after the engine has run for awhile and there is ample steam pressure built up. The use of the whistle will take away steam power and the engine will slow or stop. After the whistle is closed steam power will quickly build again. It is best to demonstrate the whistle with short bursts.

After the steam engine has been used allow the fuel capsule to burn out on its own, either under the boiler or taken out of the steam engine. The steam engine should be put into the back tool room to allow to cool and dry out before it is put away. It is best to remove the smoke stack to allow the inside to dry out.

All water should be dumped out of the boiler so that it does not leave a permanent residue on the water level glass. Wipe down the engine with a towel or rag to dry off the excess water.

### **Evaluation:**

Evaluation sheet provided to the teacher, feedback from the teacher to the educator.

### **Additional resources:**

Mississippi River Museum archives, copies of boat building plans or *WoodenBoat* magazine.

### **Extensions:**

Build small sailboats out of supplied small wooden boat hulls, masts, and paper to cut out a sail for the student boats. The boats are then “sailed” in water-filled “canal” and powered by wind from the student. The boats can be timed to determine the boat race winner. Discussion can be done later on why some boats worked better than others (ie: too large of sail, too small of sail, too much side wind, top heavy, mast mounted crooked, not heavy enough keel, etc. etc.)

Tour boats (*Logsdon* and *William M. Black*) that have been made from wood, steel, or fiberglass, and study the construction process.

Launch the museum boat into the Ice Harbor to experience what a n actual boat launch would have been like.

Watch some of the short movie segments in the second floor steamboat salon. This talks about the development of the steam boat and steamboating on the Mississippi River.

Watch for the hot rivet being tossed in the *River of Dreams* movie when the locks and dams are being built.

**Credits:**

Mark D. Wagner, Iowa State University Extension, Director of Education for the National Mississippi River Museum & Aquarium; Dubuque, Iowa