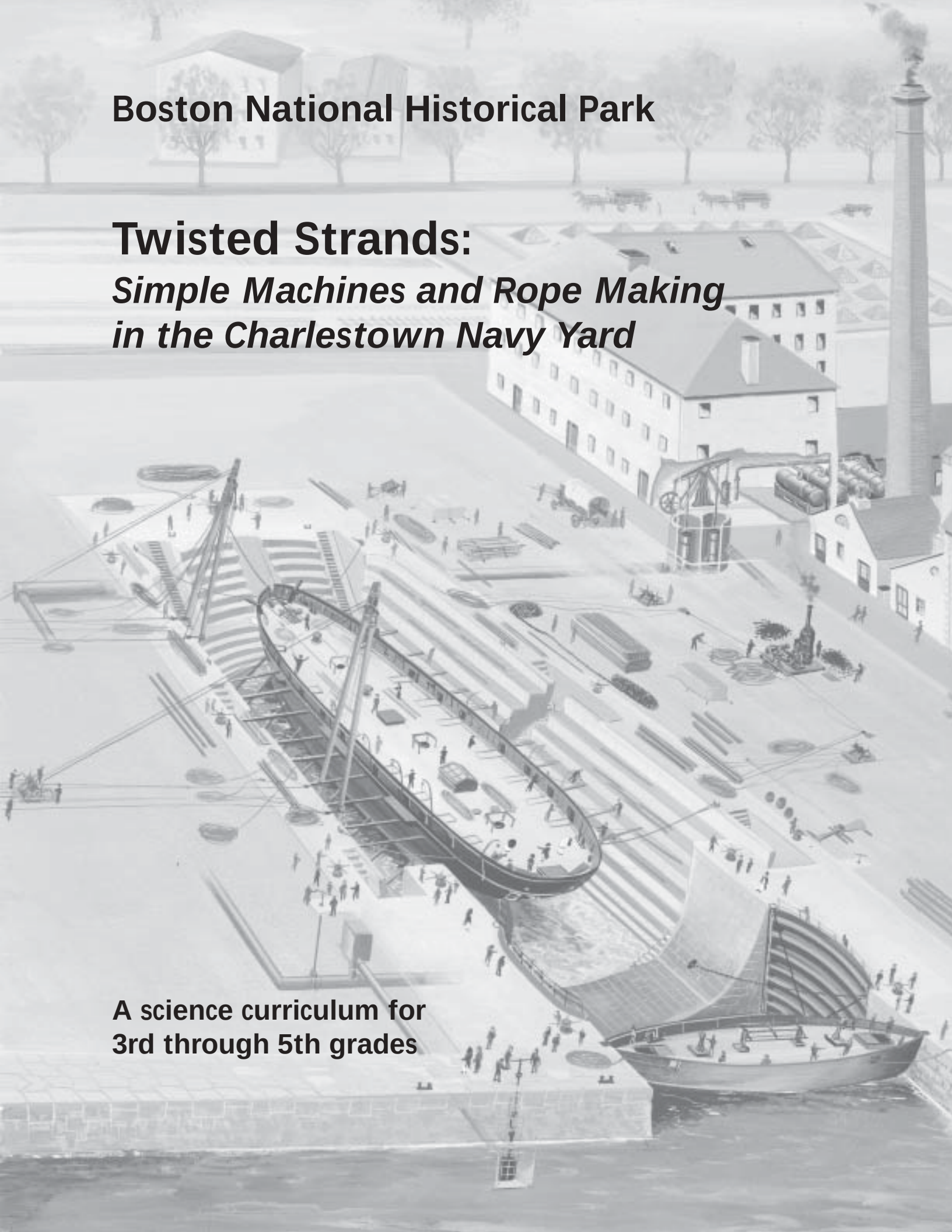
Boston National Historical Park

Twisted Strands:

Simple Machines and Rope Making in the Charlestown Navy Yard



A science curriculum for 3rd through 5th grades

Twisted Strands:
Simple Machines and Rope Making in the Charlestown Navy Yard- 3rd– 5th Grades

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Boston National Historical Park extends our thanks to the following teachers, evaluation consultant and park staff who created the "Twisted Strands: Simple Machines and Rope Making in the Charlestown Navy Yard" education program and pre-visit materials:

Teachers: Carol Airasian, Karen Flanagan, Kitty H. Hillson, Noreen O'Connell, Marilyn Zavorski
Park Staff: Dan Gagnon, Emily Prigot, and Sheila Cooke-Kayser
Evaluation Consultant: Marilyn Weiss Cruickshank

Special thanks to National Park Service Northeast Regional Historian Louis Hutchins for contributing his expertise on the history of rope making history and the Charlestown Navy Yard ropewalk.

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Eastern National
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NATIONAL PARK SERVICE

PARKS AS CLASSROOMS

Cover image depicts the mastless USS *Hartford* being dry docked for installation of its steam engine at dry dock 1 at the Chalrestown Navy Yard in 1859. *Credit: National Park Service, Harpers Ferry Center, artist John Batchelor.*

Other photographs were taken with a digital camera provided by a grant from the National Park Foundation trough generous support of KODAK, a proud partner of America's National Parks.

Twisted Strands:
Simple Machines & Ropemaking in the Charlestown Navy Yard

Table of Contents

Simple Machines and Charlestown Navy Yard
Boston National Historical Park
Pre-visit materials

What is Boston National Historical Park?

In 1974 U.S. Congress added a new National Park Service site by creating Boston National Historical Park. Today the park is distinctive, mixing historic buildings and landscapes owned by the city, the federal government, and private organizations. Only three sites are owned by the National Park Service: Charlestown Navy Yard, Bunker Hill Monument and Dorchester Heights Monument. National Park Service rangers offer educational programs to introduce students and teachers to the park's diverse cultural resources. The themes of these resources include Boston's role during the American Revolution, the founding of a new nation, and the establishment of one of the first naval shipyards to support the U.S. Navy.

The mission of the National Park Service is to preserve and protect our nation's natural and cultural resources for future generations. Today Boston National Historical Park is one of 388 National Park Service units preserving your heritage. In Massachusetts alone there are eighteen park areas. From Cape Cod National Seashore to Springfield Armory National Park to Lowell National Historical Park, rangers are interpreting the cultural and natural resources of these national treasures. To learn more about other education programs offered in all National Park sites in Massachusetts visit www.nps.gov/ERT.

Why simple machines?

Since 1984 park rangers have presented an education program about women working in the navy yard during World War II. "Rosie the Riveter" program met the fifth grade social science curriculum frameworks, but the frameworks have changed. The park staff invited elementary and middle school teachers to a teacher institute to explore the navy yard's resources and connections to the state's frameworks. In August 2003 twenty teachers attended this institute and discovered that the navy yard's technology would fit the state's science/technology curriculum frameworks for 3rd through 8th grades. They proposed to develop educational programs that would focus on simple machines integrated into the complex machinery of the yard's operations. They also identified how these programs could also incorporate learning standards in math, history and social science, English/language arts, and arts curricula. Five teachers who attended the institute continue to work with park staff on the development and evaluation of this program. Boston National Historical Park staff extends its appreciation to Carol Airasian from Winship School, Kitty Hickcox-Hillson from Derby Academy, Noreen O'Connell from Morse School, and Karen Flanagan and Marilyn Zavorski from Applewild School.

Third through fifth grade students will discover the simple machines and technology associated with making rope and the ropewalk structure. Sixth through eighth grade students will discover the simple machines and technology associated with repairing ships and the dry dock.

The two programs' pre- and post-visit materials include primary sources, historical images, background information and activities designed by the teachers. The on-site visit to the Charlestown Navy Yard includes hands-on activities and a tour of the Navy Yard and USS Cassin Young, a World War II destroyer.

Twisted Strands:

Simple Machines and Rope Making in the Charlestown Navy Yard- 3rd- 5th Grades

Learning Goals and Objectives:

Goals

The student will:

Gain knowledge of rope making technology
Understand the importance of rope for ships
Understand the role of the Charlestown Navy Yard in building the U.S. Navy

Objectives

The student will:

Identify and explain the difference between simple machines and complex machines
Identify simple machines and complex machines associated with rope making and ships
Describe the materials and technological process to make rope
Identify rope as an important tool on ships and describe the many uses of rope on ships

Field Trip Logistics

Location

Charlestown Navy Yard is located in Charlestown, Massachusetts. ***From South:*** I-93 N to exit 28(Sullivan Square). At end of ramp, turn right onto Cambridge St to first light. Enter traffic circle and take first right onto Rutherford Ave. Move to left lane and at City Square, just before bridge, turn left onto Chelsea St. Follow directions for all (below) ***From West:*** Mass Turnpike to I-93 N. Follow above. ***From North (Route 1):***Rte 1 South over Tobin Bridge. Follow signs for Charlestown. Exit is 1 mile after bridge and takes you into tunnel. In tunnel, follow exit sign for Charlestown and proceed to light. At light, turn right onto Rutherford Ave and immediately get into left lane. At next light, turn left onto Chelsea St. Follow directions for all (below) ***From North (93 South):***I-93 S. to Exit 28/Sullivan Square. Stay left on exit ramp for about 1/3 mile. Proceed up ramp to Rutherford Ave. Follow signs for Rutherford Ave/City Square. After Bunker Hill Community College, get into left lane. Just before bridge at City Square turn left onto Chelsea St. Follow directions for all (below) ***For All:*** At first light, turn right onto Warren St, then first left onto Constitution Rd. Visitor Center is on Constitution Rd on right.

Time

The program will last two hours. Programs are offered only from 10 a.m. to noon on Tuesdays in May or June.

Chaperones

We require a minimum of 1 chaperone for every 10 students.

Restrooms

Restroom facilities are located in the Charlestown Navy Yard Visitor Center. Please have your bus drop you off at the Visitor Center and allow time for your group to use the facilities. The park ranger will meet your group here.

Accessibility

Unfortunately, the USS *Cassin Young* WWII/Cold War destroyer ship is not handicapped accessible. Please let us know ahead of your visit if your class has any special needs. The visitor center and the rope making activity are accessible to all.

Bus Parking

After dropping off the students continue on Constitution Road to the set of lights.

* Turn right onto Chelsea Street.
* Follow Chelsea Street to the end.
* Travel over a small water channel where you will see signs for Bus Parking on a wooden fence.
* Turn right into Mystic Pier 1 property and proceed to Station 1. Wait for attendant to sign in.

Note: Follow route exactly. Arrivals from Terminal Street will be refused admission.

Check in procedure

* Follow signs to Autoport lot.
* Pull vehicle up to fuel aisle.
* Driver must fill out an invoice.
* After invoice is completed, driver must follow attendant to designated parking spot.
* After parking vehicle, driver may go to the driver facility in the dormitory or wait in the bus.

Walking around the facility is not allowed.

Boston Autoport is a privately owned and operated facility offering bus parking. It is not affiliated with Boston National Historical Park.

Price

Per motor coach: $20
Per school bus: $10

Services

Boston Autoport will house up to 50 motor coaches and buses per day. Services include:

* 24-hour Security
* Driver's Dormitory (prearranged use)
* Fuel Facility
* Rest Area

Visitor Center Shop

Eastern National Association, a non-profit organization, operates the park's shop and offers a 10% discount to teachers.

Food, Drink, and Photography

Eating and drinking are not allowed during the program. Groups may bring their lunch and eat outdoors on the grassy area in the Navy Yard. Photography is allowed in all areas of the park.

USS *Constitution*

Tours of the USS *Constitution* are conducted by the U.S. Navy and they do not take group reservations. If you wish to take your students on a tour of this ship after the *Simple Machines* program, you must allow twenty minutes to one hour to wait in line for the next available tour. The tours usually take about 25 minutes, but allow for time to go through security.

What is the Charlestown Navy Yard and why is it significant as a national treasure?

In 1798 the United States prepared to defend itself at sea. The Navy Department, hoping to build six ships, established six naval shipyards in 1800-01 under President John Adams. The young nation was spurred by the depredations of the Barbary pirates of North Africa and French privateers, who had been plundering U.S. merchant shipping in the 1790s. These shipyards were built in Portsmouth, N.H.; Boston, New York; Philadelphia; Washington, D.C.; and Norfolk, Va. Except during the Civil War, these shipyards launched most of the Navy's vessels until the advent of steel hulls in the 1880s, when private yards began building them in greater number.

For the next 174 years the Charlestown Navy Yard built over 230 ships, hundreds of small boats, 63 barges and other service craft. Thousands of ships have been repaired here. Since 1630 Boston had always been a major shipbuilding center. By 1800 many men in Boston worked in some aspect of the maritime trades; therefore, the new navy yard employed from the local labor force. By 1822 eighty-nine men worked here. In 1853 the workforce increased to 370 men. Most of the men were born in New England- half from Massachusetts. Fifteen percent of the workforce were Irish who were hired as unskilled laborers. By the early 1900s women worked in clerical positions, but during World War I and World War II women were needed to fill many jobs. By 1943 7,700 women were working in the yard as welders, riveters, painters, riggers, and ropewalk workers. Few African Americans worked in the yard until World War II. By the end of the war, of the 32,000 workers, 8% were African Americans.

Building a warship required many different specialized occupations including **carpenters, sawyers, joiners, sparmakers, blockmakers, painters, gun carriage makers, armorers, sailmakers, blacksmiths, caulkers, riggers, coopers, ropemakers, masons, plumbers and coppersmiths**. A force of unskilled laborers was also greatly needed. Each shop had its master, **quartermen** (foremen) crew leaders, crews of mechanics, **apprentices**, laborers and a few boys (before child labor laws eliminated such positions). Apprentices started at age 16 and had to be able to read, write, and do simple math. Apprenticeships lasted 5 years.

What are simple machines and why do we need them?
Simple Machines are tools that help make work easier. Humans have been using simple machines for thousands of years. Simple machines have few or no moving parts. Complex machines have two or more simple machines working together to make work easier. Ships are complex machines with many simple machines. Let's look at eight simple machines you will find in the Charlestown Navy Yard.

Definitions

Inclined Plane: a sloping surface, such as a ramp. An inclined plane can be used to alter the ***effort*** and distance involved in doing work, such as lifting loads. Examples: ramp, slide, ski jump, staircase, ski slope, roller coaster, zigzag path up a hill.

Wedge: two inclined planes joined back to back. Wedges are used to split things or lifts things. A wedge works by moving an object or lifting an object. Examples: your teeth, blocks used in a foot race, chocks are wedges used to put under a wheel, axe, zippers actually have 3 wedges – 2 wedges to close the zipper and one wedge to force the teeth of the zipper to open, ship's hull, knife, scissors, plow.

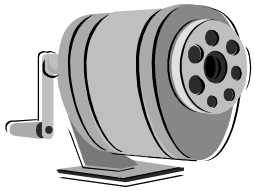
Lever: a straight rod or board that pivots on a point or support known as the **fulcrum.** It lifts objects. Examples: seesaw, the claw of the hammer, bottle opener, wheelbarrows, pushcart, baggage carrier's cart, pliers are two levers, human jaw, nutcracker, fishing rod when you are pulling in a fish, brake levers on your bike, drawbridge.

Pulley: a wheel that usually has a groove around the outside edge. This groove is for a rope or belt to move around the pulley. Some pulleys are used to change direction of a force. Other pulleys are used for lifting. Pulling down on the rope can lift an object attached to the rope. Examples: flagpole pulley to raise the flag, cranes have pulley systems, venetian blinds have small pulleys, ships use lots of pulleys to hoist the sails or raise the anchor.

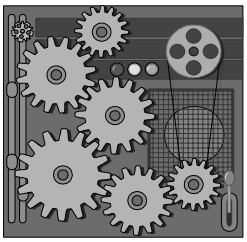
Screw: an inclined plane wrapped around a cylinder to form a spiral. Screws help to pull one thing to another. You may use a metal screw to put two pieces of wood together. Examples: soda bottles and jars have screw caps, corkscrews, propellers on airplanes or boats act like screws pulling the plan through the air or the boat through the water, drill bit, spiral staircase, spiral slide.

Wheel and Axle: People have been using wheels for thousands of years. Wheels are round. They turn to make things go. Toys, bikes, skateboards, cars and trucks all have wheels to move.

A wheel and axle has a larger wheel (or wheels) connected by a smaller cylinder (axle) and is fastened to the wheel so that they turn together. When the axle is turned, the wheel moves a greater distance than the axle, but less force is needed to move it. Examples: car, bike, door knob, skateboard, roller blades.



Wheel and crank: Some things might have a handle that turns a wheel. The handle is called a crank. Examples: pencil sharpener, jack-in-the-box toy.



Gears: Two toothed wheels fit together either directly or through a chain or belt so one wheel will turn the other. When the teeth of a gear fit on the teeth of another gear this is called meshing. Examples: gears on bike, clock, hand drill, egg beater, windmill, sawmill.

Activity # 1
What do you know about simple machines?

Give students a copy of Simple Machines definitions. Go over the definitions of each simple machine. Create two separate flipcharts with these questions or write the questions on a blackboard:

Flipchart # 1: What do you know about simple machines?

Flipchart #2: What would you like to learn about simple machines?

Write down your students' answers on the flip charts or have them write their answers down and collect their papers. Ask students to make a list of simple machines they might find in your classroom or in the school. Ask them to find a simple machine found in a complex machine. For example a pencil sharpener has gears, and a wheel and crank to work. Save your flipcharts or the students' individual papers with their answers to review after your visit to the Charlestown Navy Yard.

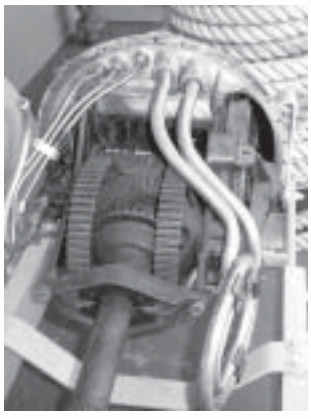
Activity # 2
Identify Simple Machines on USS *Cassin Young,* World War II Destroyer Ship

During your visit at Boston National Historical Park you will go on board the USS *Cassin Young*, a World War II destroyer ship. Your students will be divided into groups to search for simple machines found on the ship. Each group will identify the simple machine parts and discuss what function that simple machine serves. Groups will be given worksheets to identify any simple machines they find. To help your students become familiar with the ship this activity shows photographs of the ship and some examples of simple machines and complex machines with simple machine parts they will find.

Have your students look at the photographs of simple machine parts found on board the USS *Cassin Young*, a World War II destroyer.

Ship's Hull

Torpedo Drive



Torpedo Drive Shaft Gears

Hatch opening

Activity # 2 continued

Engine room telegraph

Ropes and Pulleys

Fan

Cable Reel

40mm Gun

Block (pulley)

Activity # 3
Simple Machine Lesson Plan Activity

Created by Karen Flanagan, Applewild School

Bring to your class examples of simple machines or photographs of simple machines or complex machines with simple machine parts for your students to identify. Examples of simple machines are included in the "What are simple machines?" section on pages 10and 11.

1. Students may work individually or work in small groups to identify the examples of simple machines or complex machines the teacher will distribute.
2. Give each student copies of the simple machine definitions on pages 10and 11. Provide enough copies of the "Simple Machine" worksheet on page 15 to identify all examples.
3. Give the students one to three minutes to identify the machine and discuss how it makes work easier. If the object is a complex machine they will identify the simple machines found within the complex machine. For example, a bike has multiple simple machines. They will write down their answers/discoveries on the "Simple Machine" Worksheet.
4. Students will then switch machines until all students have examined every example.
5. Students will then discuss their discoveries. Students will take turns to hold up the different examples and identify the machine and explain how the simple machine makes the work easier.

Activity # 4 (optional)
Simple Machine website activities

Visit these websites for activities on simple machines. Select activities for different types of simple machines for your class to try. Include one pulley experiment to introduce your students to rope as an important tool for pulleys. These websites were active as of March 2004.

http://www.coe.uh.edu/archinve/science/science_lessons/scienceles1/finalhome.htm
http://www.usoe.k12.ut.us/curr/science/sciber00/8th/machines/sciber/intro.htm
http://www.ed.uri.edu
http://www.smartown.com/sp2000/machines2000
http://www.sirinet.net/~jgjohnso/simple.htm
http://www.mikids.com/Smachines.htm
http://www.wcsscience.som/simple/machines.html

Simple Machines Quiz

http://www.smartown.com/sp2000/machines2000/quiz.htm

Pulleys

http://www.grc.nasa.gov
http://www.galaxy.net/~k12/machines/pulley2.shtml

Simple Machine Worksheet

Name(s)_____

Date_____

Name of the simple machine:_____
If this is a complex machine identify the simple machine parts:_____
_____
_____
_____

Describe how it makes work easier: _____
_____
_____
_____

Name of the simple machine:_____
If this is a complex machine identify the simple machine parts:_____
_____

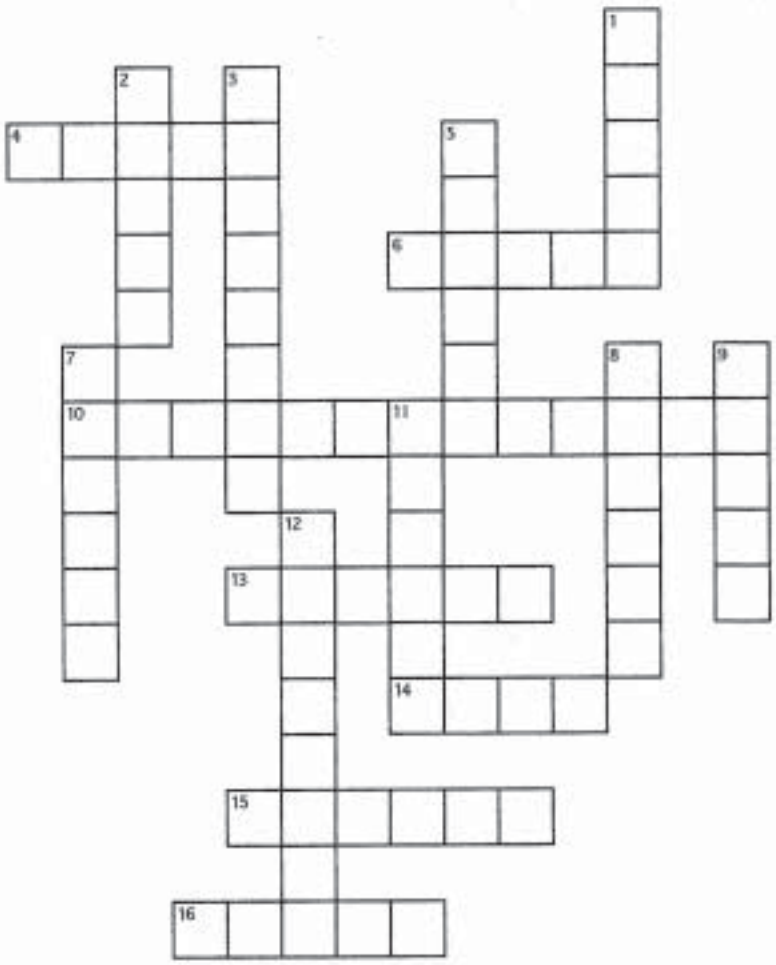
Describe how it makes work easier:_____
_____
_____
_____

Name of the simple machine:_____
If this is a complex machine identify the simple machine parts: _____
_____
_____
_____

Describe how it makes work easier:_____
_____
_____
_____

Activity # 5

SIMPLE MACHINES



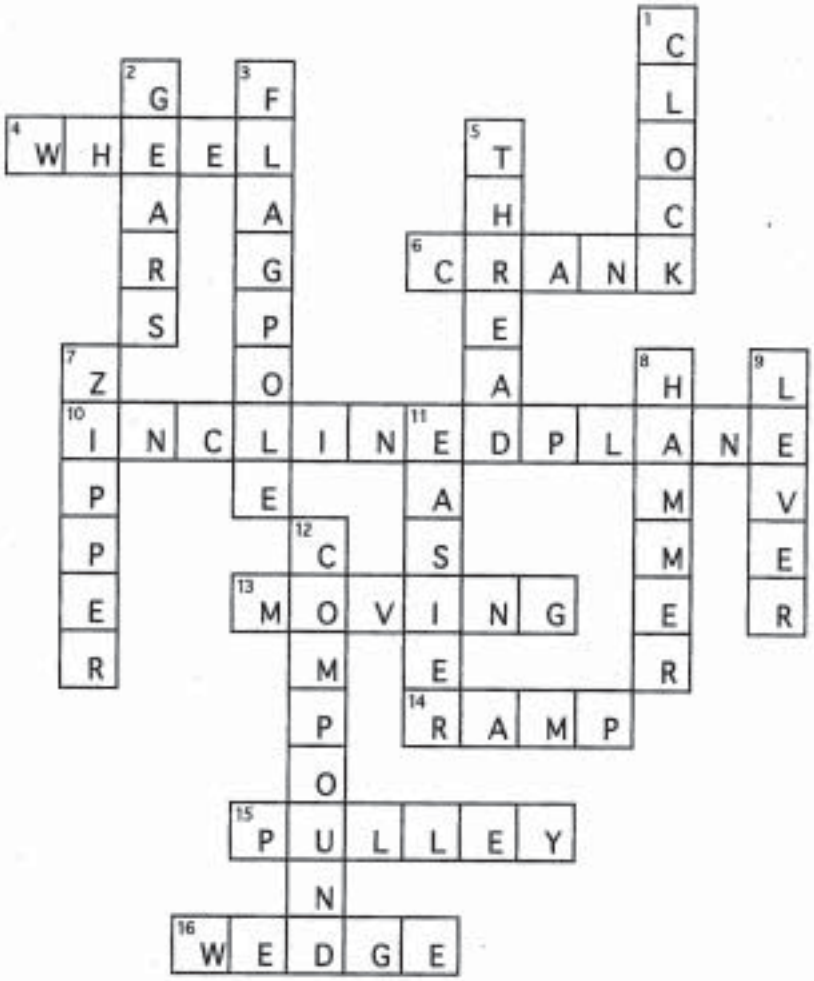
ACROSS

4 machines that are round and turn to make things go
6 the handle that turns a wheel
10 a sloping surface used to alter the effort and distance involved in doing work
13 Simple machines have no _ _ _ _ _ _ parts.
14 an example of an inclined plane
15 a wheel that usually has a groove around the outside edge
16 two inclined planes joined back to back

DOWN

1 something that has gears
2 two toothed wheels that fit together
3 an example of a pulley
5 the groove on a screw
7 an example of a wedge
8 an example of a lever
9 a straight rod or board that pivots on a point used to lift objects
11 Simple machines are tools that help make work _ _ _ _ _ _
12 two or more simple machines working together

SIMPLE MACHINES



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12 two or more simple machines working together

Rope making

Historical Background

In your visit to Charlestown Navy Yard your students will be learning about simple machines involved in rope making. Rope has been a very important tool for people to use. We do not know when people first started to make rope, but rope making existed in ancient times. Rope is mentioned in early Greek stories and shown in Egyptian hieroglyphics.

To make rope you need special plant **fibers**. In the early days rope was made of natural vegetable fibers. The natural fibers were **hemp**, **sisal** and **manila.** Some rope is still made from these natural fibers today, but most modern rope is made from **synthetic** or man-made materials like nylon. The majority of rope made for the U.S. Navy was hemp. These fibers must be strong and **pliable** to be twisted together. The fibers used from these plants might be from the stalk or leaf of the plant. The tissue of these plants is made up of cells. The cells inside hemp, sisal and manila look like long tubes. These long tube cells make these fibers strong and pliable so they can be twisted together to make rope.

The **fibers** are spun into yarn; then a group of yarns is twisted into a strand; finally, several strands are twisted together to make rope. Most ropes are made of three strands, but some ropes may have four or more strands. The strength of rope depends on the fiber used, the size of the circumference of the strands, and number of strands used to make the rope. Hemp fiber provides the strongest rope.

How do you make rope?

Please show the CD ROM presentation created by Applewild School teacher Marilyn Zavorski, sent with this packet. Review the images from the presentation with your class and discuss the step-by-step process of rope making described below.

19th century rope making required several steps. Have your students watch "Hemp for Victory" or "Industry on Parade" to see the process.

1. Clean and straighten the natural fibers. This is like combing long hair. You use a tool called a **hackle** or **hatchel.** The fiber was combed into long strips called **slivers**.

Small wooden hand hackle

Look at the photographs of the spinning machinery on the second floor of the ropewalk.

2. The slivers were spun into yarn. The Charlestown Navy Yard had very large spinning machines located on the second floor of the ropewalk. The machines were operated by many simple machines including gears and pulleys.

3. Rope used on board ships needed to be waterproof. To do this the yarn was soaked in **tar.** In Charlestown Navy Yard the tar was heated in large tanks in a separate building called the Tar House.

4. Then the yarn was wound onto large wooden bobbins.

5. The bobbins of yarn were put on a large rack.

6. The yarn was pulled from the bobbins through a metal plate called a **register.** The yarn was then twisted into a long strand. A machine called a **forming machine** twisted the yarn to make a strand as long as the ropewalk. The forming machine was on a rail similar to a railroad track inside the ropewalk. The ropewalk was ¼ mile in length; therefore, the longest strand was ¼ mile.

This photograph shows the bobbins with the yarn twisting into three strands and part of the forming machine.

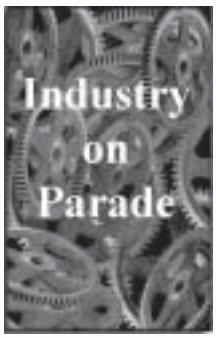
Ropemaker James Lee is working the laying machine that makes the final rope.

7. Three strands were then put on a laying machine and twisted into a rope. The laying machine was a cart that also ran on a track inside the ropewalk. As the cart moved down the track it twisted the strands into rope. The longest rope was the length of the ropewalk.

Activity # 6 *Industry on Parade* Video (15 minutes)
(Show this video just a few days before your on-site visit)

During your visit to the Charlestown Navy Yard your students will participate in two rope making activities. To familiarize your students to the rope making process at the Charlestown Navy Yard ropewalk, please show them this video. "Industry on Parade" film was produced by the National Association of Manufacturers from 1950-1960 to show the marvels of American industrial technology in operation. These films also illustrated how the industrial process results in higher living standards, to show new developments in the fields of science, invention, and research, particularly as they contribute to health, welfare, and national defense. The films also showed the integral part that industry plays in economics and to show people who work in industry.
This video shows the Charlestown Navy Yard ropewalk in operation and illustrates each process from hackling the hemp to the finished rope. The end of the film also includes silent outtakes. Go over the rope making process described above with your students before they watch the film. Ask them to identify each process they see.

1. Have your students discuss the film and answer the following questions
    a. Why do you think this film was produced in the 1950s? (After their answers you may discuss why the National Association of Manufacturers made this as described in the above paragraphs.)
    b. How does this rope making technology represent a higher living standards or does it contribute to health, welfare, national defense or economy?
    c. Who would have watched this film in the 1950s?
    d. Describe the rope making process you watched in the film.
    e. Identify any simple machines within the complex machines you saw in this film.
    f. Now watch the silent outtakes and identify each process you are seeing. Why do you think a policemen or security officer is in the film?



Activity # 7
How strong is rope?

Ropes made of different materials have different strengths. The rope makers in the Charlestown Navy Yard tested the weight and strength of their ropes. Ropes used for the anchor on a ship needed to be extremely strong. Ropes used for the **rigging** on the ships to **hoist** the sails were smaller than the anchor ropes but still had to be strong to pull up the heavy canvas of the sails.

Rope makers often had a chart that identified the strength of different types of rope. The chart below is from *Wire Ropes and Cordage* by Capt. D. E. Grant, a British book about rope written in 1933. The chart identifies the maximum strength of hemp rope based on the **circumference** of the rope. For example, a one inch circumference rope could carry a maximum strength of 750 lbs.

In the second part of this activity select items for your students to weigh or have your students research the weights of certain heavy objects that might weigh more than one ton such as an elephant. Students will then determine which size rope should be used on a pulley system to haul that item off the ground. Have your children read *How do you Lift a Lion?* by Robert E. Wells.

One ton equals 2,240 lbs.

Circumference in inches	3-strand	4-strand
1	500 lb.	750 lb.
1 ½	750 lb.	900 lb.
1 ¾	1,000 lb.	1500 lb.
2	1 ton	1 ton and 750 lb.
2 ½	2 tons	3 tons
3	4 tons	4 tons and 1,000 lb.
3 ½	5 tons and 500 lb.	6 tons
4	8 tons	8 tons and 1,500 lb.

Activity # 8
How is rope used today?

Have your students identify different uses of rope at school and at home. Rope is used not only as a tool in a simple machine, but also used for recreation purposes like jump rope.

Do the same activity as you did in Activity # 1. Find out what your students already know about rope and its many uses and what they would like to know about rope especially rope used on ships. Questions to write on flipcharts or blackboard:

What do you know about rope and its many uses?
What do you want to know about rope and its many uses?
What do you know about rope used on a ship?
What do you want to know about rope on ships?

Below are pictures of rope on board the USS *Cassin Young*. How is the rope being used on board this ship? How much rope might you need on a ship?

Where did they make rope?
Historical Background on ropewalks in Boston and Charlestown Navy Yard Ropewalk

In the 1800s rope was made in a long building called a rope walk. It was named this because the spinners walked backward down the length of the building spinning the yarns. Many ropewalks were outside in an open field. They needed to make the rope at least a quarter of a mile long and had to work in a straight line to make the rope.

In Boston many ropewalks were located near the wharves. Because they had to use hot boiling tar to make the rope waterproof, they often had many fires. Ropewalks were often located near the waterfront or outside the towns.

In 1813 Commandant William Bainbridge suggested building a ropewalk at the Charlestown Navy Yard. It took twenty-one years before plans were presented and approved by Congress to build the U.S. Navy's first ropewalk. Congress approved $50,000 to build it and Alexander Parris designed the building and worked closely with Daniel Treadwell who invented mechanized spinning, hackling and roving machines for rope making. Parris designed a 1,300 ft. structure. He used heavy timber framing and rough granite exterior walls backed by brick. This long building would allow rope to be made in the 1,200 ft. lengths. The building included a three-story headhouse (70 x 60ft.) at the east end. A second floor was built, but was only 200 ft. long to house the spinning machinery. The roofs were slate. The building was completed in 1837 and operation began on December 16, 1837.

Parris also designed two other buildings to become part of the ropewalk complex. The Hemp House and Tar House were completed by the end of 1837. The Hemp House was two stories and made of granite and served as a storehouse for hemp, the raw material for the rope making process throughout the 19th century. The Tar House was the place where the yarn was soaked in huge tanks filled with tar. The tar preserved the rope from the salt water.

In 1856 two significant changes were made to the building. Two bridges were constructed to connect the ropewalk's spinning room to the Tar House and the Hemp House. This allowed easier movement of the hemp and yarn from one building to another. Ten years later an extension to the second floor was built. The second floor was extended by 374 ft.

After a fire in 1880s in the ropewalk the Navy installed a fire sprinkler system and electric lighting. They also decided to extend the second floor again by 80 ft. A loading platform was provided on this new extension. The next major change occurred in 1919, in response to the expansion of rope making operations due to World War I and the employment of women. A 41 x 13.5 ft. brick addition to house toilet facilities for women was added on the north side.

The next changes occurred in 1942 due to the expansion of the workforce in World War II. The Navy enlarged Gate 4 next to the ropewalk for the increased pedestrian traffic; therefore, a 34 ft. section at the west end of the ropewalk was removed.

By the mid-1950s, the future of the ropewalk was being questioned. The Navy was under heavy pressure to not compete with private industry and buy their rope instead of making rope. The Navy decided to reduce their rope making operations and conduct research to discover new materials to make better rope. After 1962, only nylon rope was produced. The ropewalk finally closed in December 1971. The Charlestown Navy Yard became part of the

National Park Service (NPS) in 1974. Not all of the Navy Yard buildings became part of the National Park Service. The ropewalk was transferred to the Boston Redevelopment Authority (BRA).

Unfortunately, on May 4, 2002 a nine-alarm arson fire occurred in the Ropewalk. The BRA immediately began to repair the fire damage to the building to better secure it. Today the building is unsafe to enter, but the BRA and NPS are planning an exhibit on rope making in part of the Ropewalk. It is hoped that the rest of the building will be restored for office space or shops.

Activity # 9
Timeline of the Charlestown Navy Yard Ropewalk

Have your students create a timeline of the Charlestown Navy Yard Ropewalk from 1813 to the present day.
Include in the timeline historical events and dates in Boston's history and U.S. history.

Questions for your students:

1. Who was the U.S. President in 1837 when the Ropewalk was completed?

2. The Ropewalk opened for operation on December 16, 1837. What important historical event happened in Boston 64 years earlier? Why was this event so important? How did this event play a role in the creation of the United States?

3. Why did Alexander Parris use granite and brick in the construction?

4. How long was the second floor by 1864?

5. Why do you think they added bridges in 1856?

6. Why were there no restrooms for women before World War I?

7. What other buildings in Boston did Alexander Parris design?

8. If you worked for the Boston Redevelopment Authority, what would you propose for the future use of the Ropewalk?

9. Does your town have any old industrial buildings still standing? Are any of these buildings empty? If so, how would you propose to use these buildings today? What other uses are available for buildings that are over 100 years old in your hometown?

Activity # 10
Ropewalks in History

In March 1770 a ropewalk area in Boston played an important role in the Boston Massacre. John Gray's ropewalk was located near Congress Street.

What happened?

Starting in 1765 the British Parliament began to tax the colonists to pay for the French and Indian War. Many colonists were very angry about these taxes and felt they had no one representing them in Parliament to vote on these taxes. One famous Bostonian, James Otis, a lawyer, said "taxation without representation is tyranny." To protest the taxes the people often gathered in large mobs and threatened the Royal Governor or anyone who tried to collect the taxes for the British government. In 1768 riots in Boston were so bad that King George III sent British soldiers to Boston to stop these protests. By March 1770 the soldiers and the people of Boston did not like each other very much.

On March 2, 1770 a group of soldiers went to Gray's ropewalk to try to get a second job. Soldiers did not get paid very well and often tried to find a second job when they were off duty.

The rope makers hated these soldiers. To the rope makers the soldiers were trying to take their jobs. When a group of soldiers asked for work, rope maker Samuel Gray told them to go clean the outhouse. The soldiers did not like that job so they started a fight. The rope makers were very strong and they won the fight. The soldiers threatened to get back at them.

Three days later a group of young boys threw snowballs and chunks of ice at Private Hugh White who was on guard duty in front of the Custom House. Soon more boys and young men showed up and started throwing rocks at the soldier. A group of rope makers appeared carrying a tool called a **wooldering stick.** These sticks were three feet in length and made of wood. The rope makers used this tool to twist the strands to make rope. The rope makers often carried their own wooldering sticks with a leather strap.

The officer on duty that night heard the noise and arrived with seven other soldiers to defend Private Hugh White. One of the seven soldiers was Private Mathew Kilroy who had fought in the ropewalk fight on March 2.

Unfortunately, a wooldering stick hit a soldier and he fired his **musket** causing all the other soldiers to fire their muskets. Four men died that night including Crispus Attucks, an escaped slave. Patrick Carr died a few days later. The five men were buried in the Granary Burying Grounds.

The Sons of Liberty called this the **Boston Massacre**. Paul Revere printed a picture of the Massacre.

Look at the Boston Massacre print below. Does the picture tell an accurate story of what happened that night? Do you see any of the men throwing snowballs, ice or the wooldering sticks at the soldiers? Why do you think the picture includes a small dog?

Who made the rope?

Many men were employed to work in the ropewalks in Boston. The rope makers were very experienced and skilled **craftsmen.** The ropewalks were under the direction of a master rope maker who learned the trade himself, beginning as an **apprentice** at age 15 or so. The men who learned to spin the yarn were called **spinners**. The lead spinners were the highest paid workers. Many men did the heavy work of moving the bales of hemp or loading the finished rope on carts to transport to the ships. They worked very long hours, sometimes 12 to 14 hours a day, and six days a week. Sometimes as many as 50 men worked in one ropewalk.

Post Visit Activities
Inventions in rope making

In 1831 Daniel Treadwell of Boston was a professor at Harvard University. He liked to invent machines. He mechanized the rope making process by inventing a mechanized spinning machine. In 1831 the U.S. Navy decided to build its own ropewalk. They were buying rope from local ropewalks. The navy installed Mr. Treadwell's new mechanized spinning machinery. The hand spinners fought against this mechanization because many of them would lose their jobs.

Yet the machines could do the work faster and produced more. By 1850 few ropewalks employed hand spinners.

Post Visit Activity # 1
Inventions and Inventors

Check out websites about inventors and inventions:
www.web.mit.edu/invent/
www.blackinventor.com

A famous Bostonian inventor was Benjamin Franklin. Franklin invented many things throughout his life. He was a very practical inventor. He invented the Franklin stove in 1741, and dampers for stoves and chimneys to conserve heat and to regulate burning fires. He also invented the a musical instrument called the glass armonica, which consisted of turning glasses on a wooden rod and using wet fingers to form notes.

Research a 19th century invention such as the telegraph invented by Samuel F. B. Morse or the telephone invented by Alexander Graham Bell. Both of these inventors were from the Boston area. Who was the inventor? How does this invention make work easier? Does the invention include any simple machines? Identify the simple machines found in this invention. Do people still use this invention today? If not, why not? Is there a modern invention that replaced this invention? For example, the commercial typewriter was invented in 1868 by Christopher Sholes, Carlos Glidden, and Samuel Soule. Today, we use computers instead of typewriters as a writing tool.

Post Visit Activity # 2
Henry Wadsworth Longfellow and the Charlestown Navy Yard Ropewalk

Henry Wadsworth Longfellow was a poet who lived in Cambridge, Massachusetts. He wrote poetry. He wrote many poems about the new technology of his time. He was fascinated by machines and rope making, but he was also worried about what negative changes technology would bring to people. He visited ropewalks in Maine before they started using mechanized machinery to make the rope. His poem *The Ropewalk* describes a ropewalk with hand spinners. Some ropewalks employed women to spin the yarn into strands; therefore, Longfellow's poem often describes the spinners as female. Interestingly, inventor Daniel Treadwell and Longfellow were friends.

Have your students read the "Ropewalk" poem on page 24.

Questions for the poem:

1. *The Ropewalk* poem paints a picture by mentioning things we can see, hear, feel and smell. Find at least three examples in the poem things you can see, hear, feel or smell.

2. Why do you think Longfellow chose to use words related to our senses in this poem?

3. In the first paragraph, Longfellow says "human spiders." What does this mean? What do we call this kind of comparison?

4. The poem is about an early 18th century ropewalk before mechanized machinery was invented. During your visit to Charlestown Navy Yard you learned about the ropewalk and the machinery used to make rope. Write a poem describing the machinery used to make rope in the Charlestown Navy Yard ropewalk. How might you write a different type of poem?

5. Longfellow described the many uses of rope in his poem. Find at least three different uses of rope in the poem. Do we still use rope for this purpose today?

Longfellow wrote other poems about craftsmen making things such as *The Village Blacksmith* and *Keramos. Keramos* is about a potter who Longfellow knew in Portland, Maine. Have your class read other poems by Longfellow to compare them to *The Ropewalk* poem.

The Ropewalk
By
Henry Wadsworth Longfellow

In that building, long and low,
With its windows all a-row,
Like the port-holes of a hulk,
Human spiders spin and spin,
Backward down their threads so thin
Dropping, each a hempen bulk.

At the end, an open door:
Squares of sunshine on the floor
Light the long and dusky lane;
And the whirring of a wheel,
Dull and drowsy, makes me feel
All its spokes are in my brain.

As the spinners to the end
Downward go and reascend,
Gleam the long threads in the sun;
While within this brain of mine
Cobwebs brighter and more fine
By the busy wheel are spun.

Two fair maidens in a swing,
Like white doves upon the wing,
First before my vision pass;
Laughing, as their gentle hands
Closely clasp the twisted strands,

At their shadow on the grass.

Then a booth of mountebanks,
With its smell of tan and planks,
And a girl poised high in air
On a cord, in spangled dress,
With a faded loveliness,
And a weary look of care.

Then a homestead among farms,
With its smell of tan and planks,
And a girl poised high in air
On a cord, in spangled dress,
With a faded loveliness,
And a weary look of care.

Then an old man in a tower,
Ringing loud the noontide hour,
While the rope coils round and round
Like a serpent at his feet,
And again, in swift retreat,
Nearly lifts him from the ground.

Then within a prison-yard,
Faces fixed, and stern, and hard,
Laughter and indecent mirth;
Ah! It is the gallows-tree!
Breath of Christian charity,
Blow, and sweep it from the earth!

Then a school-boy, with his kite
Gleaming in a sky of light,
And an eager, upward look:
Steeds pursued through lane and field:
Fowlers with their snares concealed
And an angler by a brook.

Ships rejoicing in the breeze,
Wrecks that float o'er unknown seas,
Anchors dragged through faithless sand;
Sea-fog drifting overhead,
And, with lessening line and lead,
Sailors feeling for the land.

All these scenes do I behold,
These, and many left untold,
In that building long and low;
While the wheel goes round and round
With a drowsy, dreamy sound,
And the spinners backward go.

Resources

For Teachers:

Charlestown Navy Yard and Boston National Historical Park
www.nps.gov/bost/

Websites on simple machines and complex machines

http://howstuffworks.com
http://edheads.org/activities/simple-machines/
http://www.ed.uri.edu
http://www.grc.nasa.gov

Websites on hemp and rope
Be careful with sites on hemp and rope making. They might include marijuana information. But for the teacher there are wonderful facts, stories and pictures.

http://www.rexresearch.com/hhist/hhist2~1.htm
(Hemp history in America, Chapter Two by Robert A. Nelson

http://www.thedockyard.co.uk/ropery.html

http://www.rope-maker.com
(Home page includes rope making history.)

http://www.workbenchmagazine.com/gallery/257-rope.html
(Includes a picture of a rope making machine used on a farm.)

http://www.naihc.org/hemp_information/hemp/facts.html
http://www.hempology.org

Inventions and Inventors

http://www.mit.edu/cpse

http://www.girltech.com/Invention?

http://www.blackinventors.com

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Armentrout, David and Patricia: *A Screw (How Can I Experiment With Simple Machines?)*, Children's Press, 2003

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Fowler, Allan, *Simple Machines, Rookie Read-About Science Series*, Children Press, Grolier Publishing, NY, 2001.

Macaulay, David, *The New Way Things Work*, Houghton Mifflin Co., 1998.

Wells, Robert E., *How do You Lift a Lion?* Albert Whitman & Co., Morton Grove, Illinois, 1996.

Appendix 1
Boston National Historical Park
Twisted Strands: Simple Machines and Rope Making at Charlestown Navy Yard
Pre and Post Visit Activity Chart

Activity & Time	Skills	Curriculum Links	Page #
Activity # 1 What do you know about simple machines? *Time: 30 minutes*	critical thinking brainstorming categorizing comparing contrasting vocabulary	Science & Technology -Identify & explain the difference between simple & complex machines. -Identify & explain the materials & tools	11
Activity # 2 Identify Simple Machines on USS *Cassin Young*. *Time: 30 – 45 minutes*	categorizing comparing contrasting	Science & Technology -Identify & explain the difference between simple & complex machines. -Identify & explain the materials & tools.	12 & 13
Activity # 3 Simple Machines Lesson Plan *Time: 30 minutes*	critical thinking comparing contrasting examining	Science & Technology -Identify & explain the difference between simple & complex machines. -Identify & explain materials & tools.	14
Activity # 4 Simple Machine Websites Time: Homework assignment	comparing contrasting research examining critical thinking	Science & Technology -Identify & explain the difference between simple & complex machines.	14

Activity	Skills	Curriculum Links	Page #
Activity # 5 Crossword Puzzle Time: 30 minutes	vocabulary critical thinking	English Language Arts -Identify vocabulary words. Science & Technology -Identify simple machines.	16 & 17
Activity # 6 Industry on Parade" 1950s Film Video Time: 10 minutes Discussion Time: 15-30 minutes	analyzing a primary source observing examining listening	Science & Technology -Identify machines. -Identify & explain the steps of a process. English Language Arts -Identify & apply steps in conducting & reporting research. History & Social Science -Observe visual sources such as photographs & films to describe clothing, setting and action.	20
Activity # 7 How strong is rope? Time: 45 minutes	critical thinking researching comparing contrasting examining creating a chart	Science & Technology -Identify materials used to accomplish a design task. -Identify & explain the materials & tools. -Conduct tests for weight, strength of materials. Math -Demonstrate an understanding of such attributes as length & weight.	21

Activity	Skills	Curriculum Links	Page #
Activity # 7 (cont.)		-Solve problems involving proportional relationships & units of measurement. -Identify, measure, & describe circles & the relationships of the diameter & circumference.	21
Activity # 8 How is rope used today? Homework assignment	researching critical thinking comparing contrasting brainstorming	Science & Technology -Identify materials used to accomplish a task. -Identify & explain materials & tools. English Language Arts -Identify & apply steps in conducting & reporting research.	22
Activity # 9 Timeline of Charlestown Navy Yard Ropewalk Time: Homework assignment and 1 hour of class time for discussion or creating the timeline	researching creating a timeline analyzing a primary source	History & Social Science -Identify & interpret historical events -Explain the meaning of time periods & dates. English Language Arts -Identify & apply steps in conducting & reporting research.	24

Activity	Skills	Curriculum links	Page #
Activity # 10 Ropewalks in History Time: 45 minutes	researching analyzing a primary source imagining critical thinking comparing contrasting examining	History & Social Science -Explain important political & economic events leading to American Revolution -Observe & identify primary sources such as drawings. English Language Arts -Identify & apply steps in conducting & reporting research. Arts & Visual Arts -Describe & analyze the work of others.	25 & 26
Post Visit Activities			
Post Visit Activity # 1 Inventions & inventors Time: 30 – 45 minutes	research reading & writing analyzing critical thinking	Science & Technology -Identify & explain an engineering design that solved a problem. -Identify communication & transportation technologies. History & Social Science -Identify 19th & 20th century inventions & their beneficial uses. English Language Arts -Identify & apply steps in conducting & reporting research.	27

Activity	Skills	Curriculum links	Page #
Post Visit Activity # 2 *The Ropewalk* poem Time: 45 minutes Or homework assignment	reading & writing analyzing understanding critical thinking discussing examining vocabulary creating researching inquiring	English Language Arts -Identify & apply knowledge of the theme, structure & elements of poetry. -Identify rhyme & rhythm, similes and sensory images in poems. -Respond to & analyze the effects of sound, figurative language, & graphics in order to uncover meaning in poetry. History & Social Science -Explain how objects of everyday life in the past tell us how people lived & worked. -Observe & identify details in an historical narrative. -Identify different ways of dating historical narratives.	28 & 29