LONG MAY IT WAVE:

Fort McHenry and the War of 1812

A National Curriculum for Grades 4 through 8

Developed by the Friends of Fort McHenry in collaboration with
Fort McHenry National Monument & Historic Shrine and the Star-Spangled Banner National Historic Trail

Funding provided by the National Park Service, Chesapeake Bay Gateways and Watertrails Network

LESSON TITLE: Pulley Systems Used at Fort McHenry

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COURSE/GRADE: Science, Adaptable to Grades 4-8

UNIT: Simple Machines
TIME NEEDED: One to two 45-minute class periods

LESSON OVERVIEW:

Students will perform a demonstration to explore the science behind the pulley systems used to move cannons and raise the "Star-Spangled Banner" at Fort McHenry.

OBJECTIVES: At the end of this investigation students will be able to:

- Explain how pulley systems helped the soldiers at Fort McHenry
- Describe the concept of the pulley system
- Calculate the amount of force needed to move an object with the pulley system

Maryland State Curriculum Content Standards for Science (Grade 4):

1.A.1 Gather and question data from many different forms of scientific investigations which include reviewing appropriate print resources, observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments
1.B.1.a. Develop explanations using knowledge possessed and evidence from observations, reliable print resources, and investigations
2.D.1.a Design and make things with simple tools and a variety of materials.

Maryland State Curriculum Content Standards for Math (Grade 4):

6.A.1.a Read, write, and represent whole numbers using symbols, words, and models

MATERIALS:

- For Lesson:
  - K-W-L Chart
  - Video Clip
  - Activity Sheet
- For Activity:
  - Small straw
  - Large thread spool
  - Scissors
  - Ruler
  - String
  - Sheets of typing paper
  - Masking tape
  - Weights
  - Pulleys (small and optional)

Generously funded by the National Park Service, Chesapeake Bay Gateways and Watertrails Network.

VOCABULARY:

Pulley
Simple machine
Force

PROCEDURE:

1) Warm Up

- On the board, write the words "simple machine" and "Fort McHenry."
- Have the students list what they know about Fort McHenry and simple machines – anything at all.
- Then have the students explain why the words might relate to each other.

2) Engagement

- Have students fill out a K-W-L chart with the teacher using their ideas from the warm up.
- Tell the students that they will be traveling back in time to the War of 1812. We will be learning about how the soldiers used simple machines to help them move items at Fort McHenry.
- Briefly relate the history of Fort McHenry: Ft. McHenry was built to help protect Baltimore from attack by enemy forces. During the War of 1812, Baltimore attacked by the British. As the British tried to sail into the Baltimore Harbor, the soldiers at Fort McHenry fired cannons at the ships. Some of these cannons weighed over 1,000 lbs.
- Ask: How do you think a soldier that weighs 150 lbs moved a 1,000 lb cannon?
- Continue the story: Also, on September 15, 1814, after surviving a 25-hour bombardment by the British ships, the soldiers at Fort McHenry raised a huge flag (30 X 42 ft) above the fort on a tall flag pole. Francis Scott Key, who had watched the battle from amid the British fleet, saw the flag, knew that the Fort had not fallen, and was inspired to write "The Star-Spangled Banner," the song that is today our National Anthem. The soldiers used a pulley system to raise that flag, which was made of wool bunting and was very heavy.
- Tell students that today we will be investigating this pulley system.
- Show the You Tube video clip of the flag rising at Ft. McHenry. Tell students that this is one way a pulley system helped the soldiers. Video clip found at: http://www.youtube.com/watch?v=LSStmWeBoCA&feature=related.
- Explain to students that there is a pulley system at the top of the flagpole. Show a pulley if you have one.
- Explain that pulleys help reduce the amount of force you need to pull something.

3) Exploration

- Students will then create their own flag pole using the materials and answer questions about the activity. (See activity sheet.)
- Place students in groups. Depending on your class, you can guide your students through the activity or have them do it on their own.

1.Place straw through the hole in the thread spool. The spool must turn easily on the straw.
2. Collect a piece of string and tie the ends together.
3. Color the sheet of typing paper to appear like an American flag.
4. Tape the flag to the string.
5. Place the loop of the string over the spool, with the flag hanging at the bottom of the loop.
6. Ask a person in the group to hold the ends of the straw, one in each hand at arm's length over his or her head.
7. Pull down on the string opposite the flag.
8. Observe the distance the string is pulled down and the distance and direction the flag moves.

- Students should answer the questions on the activity sheet. (See Attached)
- Allow students 25-30 minutes to complete the activity.

4) Explanation

- Review the activity sheet as a class.
- Explain: A pulley reduces the amount of force needed to pull an object. In the activity, you made a model of a pulley and investigated how they used pulleys at Fort McHenry. With a paper flag we did not need a lot of force to pull the flag up, but the Fort McHenry flag was very heavy.
- Pulleys decrease the amount of force needed to pull by one-half. For example: If I had a 50 lb flag with a pulley to help, I would only need to use 25 lbs of force to raise it up the flag pole.
- These pulleys also helped the soldiers move thousand-pound cannons. The pulleys alleviate the amount of force the soldiers need to put forth to move the cannon.

5) Enrichment

- Have the students add weights to the string attached to the flag. Have students in their groups answer the questions.

6) Evaluation:

- In their journals or as an exit ticket, have students answer the following questions:
  - How did the pulley system help at Fort McHenry? Was it easier or more difficult to move things with the pulleys?
  - If the soldiers at the Fort did not use pulleys, how do you think they could have moved the cannons or the flag?

Activity Sheet

"How Did Simple Machines such as Pulleys Help the Soldiers at Ft. McHenry?"

Name:_____
Group
Members:_____

Materials Needed:
Small straw
Large thread spool
Scissors
Ruler
String
Sheets of typing paper
Masking tape
Weights

Setting up your pulley system:

1. Place straw through the hole in the thread spool. The spool must turn easily on the straw.
2. Collect a piece of string and tie the ends together, creating a loop.
3. Color the sheet of typing paper to appear like an American flag. (We are going to create a flag with 15 stars and 15 stripes on it. This is like the "Star-Spangled Banner" flag that was flown over Fort McHenry during the War of 1812.)
4. Tape the flag to the string.
5. Place the loop of the string over the spool, with the flag hanging at the bottom of the loop.
6. Ask a person in the group to hold the ends of the straw, one in each hand at arm's length over his or her head.
7. Pull down on the string opposite the flag.
8. Observe the distance the string is pulled down and the distance and direction the flag moves.

Answer the following questions based on the simulation you created on a separate sheet of paper:

1. What did you observe when you pulled the string down? What direction did the flag go? Did you have to pull hard to get the flag to rise?
2. How does the pulley help raise the flag? What would change if you did not have a pulley to help raise the flag?
3. What do the 13 stars on the flag represent?
4. What do you think would happen if you added weight to the flag? How do you think the pulley system would help?

Enrichment Activity

If provided, attach a weight to the string on the same side that the flag is on. Attach different weights and observe what happens.

1. Weight_____

What did you notice about the force needed to pull the flag up with the additional weight?

2. Weight_____

Is there a difference in the force needed to pull the flag up compared to the other weight?

Evaluation

Answer these questions.

1. How did the pulley system help at Fort McHenry? Was it easier or more difficult to move things with the pulleys.

2. If the soldiers at the Fort did not use pulleys, how do you think they could have moved the cannons or the flag