

Be a Cooper

Build a barrel to hold and safely transport the most weight for a distance of 20 feet. (More weight will be added until only one barrel remains.)

Subjects and Skills

- ◆ Area, circumference, volume, nets
- ◆ The history of casks

Materials

- ◆ Straws
- ◆ Index cards
- ◆ Construction paper
- ◆ Paper cups
- ◆ Weight (e.g., marbles, pennies, golf balls)

Vocabulary

- ◆ Cooper
- ◆ Versatile
- ◆ Staves
- ◆ Gauging
- ◆ Net
- ◆ Diameter
- ◆ Circumference
- ◆ Volume

Purpose

Students will learn and apply geometric skills by connecting concepts with history. Understanding how to find the volume of a cask requires multiple mathematical skills necessary for students to understand broader geometric concepts.

Objectives

- Students will gain a better understanding of:
- ◆ the history of the design of the cask,
 - ◆ drawing a net of a solid,
 - ◆ finding the area of a circle,
 - ◆ finding the circumference of a circle, and
 - ◆ finding the volume of a cylindrical solid.

Activity Preparation

1. Run off activity sheets.
2. Gather materials and place in two different areas of the classroom.
3. Bookmark websites to be used in class.
 - a. http://www.history.org/Foundation/journal/Autumn03/cooper_slideshow
 - b. <http://www.scholastic.com/teachers/article/mayflower-john-alden-ships-cooper>
 - c. <http://www.rootsweb.ancestry.com/~flbbm/heritage/cooper/barrelmaking.htm>
 - d. <http://www.history.org/kids/games/cooperation.cfm>
 - e. <http://www.britishpathe.com/record.php?id=46792>
 - f. <http://vimeo.com/5391598>

Activity Procedure

1. Introduce the term *cooper*. Explain that a cooper is someone who makes casks, or barrels. Show the slideshow from Colonial Williamsburg at Link a.
2. Review the mock interview with John Alden, hired to be the cooper on the *Mayflower* in 1621, at Link b.
3. Distribute the activity sheets. Have students read along and define versatile (adaptable).
4. Continue reading together. For images and information about barrel parts, use the information at Link c. An excellent interactive activity is available through Colonial Williamsburg at Link d.
5. Have students draw the net on their activity sheets.
6. Check for understanding of geometric concepts. Review how to find the volume of cylinders, if necessary.
7. Show the video about barrel making (03:19) at Link e. or the video (02:51) at Link f.
8. Review the correct answers for the activity sheet. For Question 4, the diameter is 6 inches, the radius is 3 inches, the circumference is 18.84 inches, the area is 28.26 square inches, and the volume is 141.3 cubic inches.
9. Review the team challenge.
10. Once the challenge has been completed, have students finish filling out their sheets.
11. If you wish, assign one of the activities in Extend the Learning With Casks: Activities.

Name: _____ Date: _____

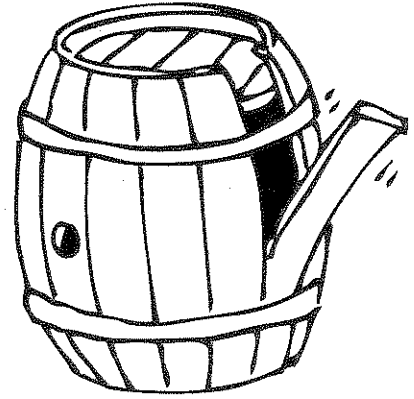
Be a Cooper

GOAL

- Build a barrel to hold and safely transport the most weight for a distance of 20 feet. (More weight will be added until only one barrel remains.)

MATERIALS

- Straws
- Construction paper
- Index cards
- Paper cups
- Weight (e.g., marbles, pennies, golf balls)



TIME TO CREATE

- 20 minutes

INDIVIDUAL ACTIVITY

Read the following, highlighting important information, and then answer the questions.

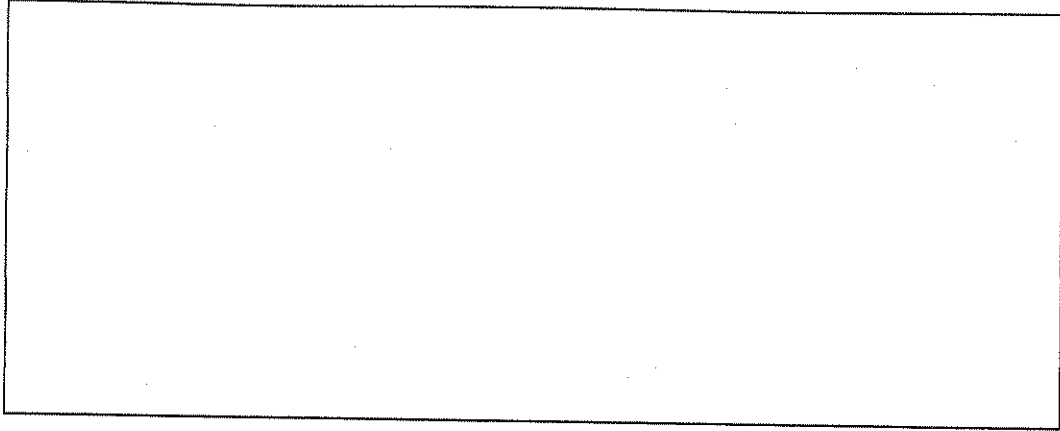
Coopers were craftsmen who made casks, which are similar to barrels. At one time, the durable casks were essential for storing everything from gunpowder to milk. Casks were tough and versatile, and because of their round shape, they were easily moved. Traders in the 1700s depended on casks for shipping their wares, such as flour, wine, shoes, books, and leeches (used in medicine) to other countries. By the 1750s, British coopers made hundreds of thousands of casks annually.

Casks have a flat bottom and a flat lid. Their sides are shaped from wooden staves (narrow strips of wood) held together by iron bands. The staves are slightly wider in the middle, which causes the barrel to be rounded and not cylindrical in shape.

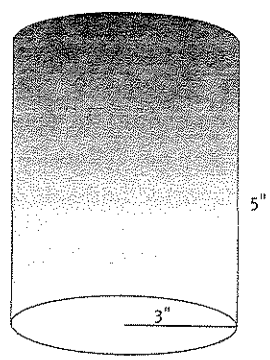
Because many products were transported and sold in barrels years ago, computing the volume of a barrel was an important skill. It was called gauging (estimating an amount). Calculating with accuracy was difficult because of the barrel's shape; therefore, gauging the volume of a barrel was to calculate its area as if it were a cylinder.

1. Define *versatile*: _____

2. A *net* is a two-dimensional shape that can be folded into a geometric solid. Draw a net of a cask.



3. What is the formula to calculate the circumference of a circle? _____
What is the formula to calculate the area of a circle? _____
What is the formula to calculate the volume of a cylinder? _____
4. What is the length of the diameter in the cylinder below? _____
What is the radius? _____
What is the circumference of the top? _____
What is the area of the bottom? _____
What is the volume? _____



TEAM CHALLENGE

Participants will work together in teams of two or three for a total of 20 minutes to make a cask from the materials provided. The cask needs to safely transport the heaviest load from one location to another, roughly the length of your classroom. Once the teacher starts the time, you will have exactly 20 minutes to gather your materials and build your cask. Once the teacher signals that time is up, you must stop working immediately and take your cask to the designated challenge site. Any team that continues to work after time has been called may be disqualified.

Start Time ____:____ + 20 Minutes = ____:____ End Time

1. What is the length of the diameter in your cylinder? _____

What is the length of the radius? _____

What is the circumference of the top? _____

What is the area of the bottom? _____

What is the volume of your cask? _____

2. What was the distance your cask was able to transport weight safely? ____ ft ____ in.

3. What was the heaviest load your cask was able to carry? _____

4. Were there any problems in your team's cask's design? Explain your answer.

5. How far was the most successful cask able to travel? ____ ft ____ in.

6. Explain what contributed to the cask's success in transporting weight the furthest.

7. What was the difference between your cask's distance traveled and the distance traveled by the most successful cask? ____ ft ____ in.

8. Explain the most important contributing element to the design of a cask for sturdiness.

9. What specific materials might be used for a cask that needed to transport liquid or be transported in water? _____

10. How would you improve on the design and/or crafting of your cask? _____

EXTEND THE LEARNING WITH TASKS: ACTIVITIES

1. **Learn about Kepler.** Johannes Kepler (1571–1630) was the first to figure out that the paths planets make around the sun are ellipses; this is Kepler's first law of planetary motion. Kepler also came up with other laws, one of which is the formula for finding the volume of a barrel. Research Kepler and write a page-long summary of what you've learned about him, focusing on his work with barrels.
2. **Volume of a barrel.** Using what you know about finding the volume of a cylinder, consider what important elements would need to be considered if you were to find the volume of a barrel. Draw a cylinder and a barrel on a separate sheet of paper. Add a radius both in the top and in the middle of each solid. Write a paragraph explaining the differences between the two solids regarding volume, and speculate about how the middle radius might be used to find the formula for the volume of a cylinder. Once you've written this paragraph, conduct research to find the formula for finding the area of a barrel. Write a second paragraph explaining how this formula relates to your expectations and predictions.
3. **Rain barrels.** Visit http://www.naturalrainwater.com/make_rain_barrel.htm; http://www.cityofbremerton.com/content/sw_makeyourown_rainbarrel.html; and http://www.youtube.com/watch?v=q8_72a9BDHU&feature=related to research making a rain barrel (used to collect the rain that runs off of your roof during a rainstorm). Construct a rain barrel and measure how much water it collects the next time it rains. Take a photo of your rain barrel, and bring it in with a results sheet.