

Name: _____ Date: _____ Period: _____

Good, Better, Best Container-Cylinder

Recall: What is the formula to calculate the Volume of a Rectangular Prism?

$V =$ _____

Predict:

1. Will the formula work for Cylinders? What does B mean in the context of a cylinder?

B represents _____

I predict the formula will / will not hold true for cylinders because _____

_____.

Building a Cylinder and Testing out your Formula

- You will be given a baggie of beans (to represent the volume), cardstock, tape and scissors. You can use 2 sheets of cardstock to build the prism.
- You need to use the beans, cardstock, scissors and tape to build a cylindrical container that will hold the beans perfectly (all the beans fit and there is not extra space). Make sure to include the top and bottom of your container.

Picture of your container (label the dimensions)

Calculate Volume

Apply the formula for the volume of a rectangular prism to calculate the volume of the cylinder you just built. Show your math below.

$V =$

Comparing Class Volume

Share the volume of your cylinder which you calculated using the formula for a rectangular prism.

What do you notice about the volume of each group's cylinder?



Does the Formula work for Cylinders?

Your baggie contained 750 ml of beans.

1. How does this volume compare to what you calculated using the formula for a rectangular prism?

2. How does the volume compare to the rest of the class's calculated values?

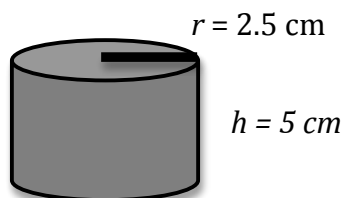
3. Based upon this evidence, would you say the formula for calculating volume of a rectangular prism also works for a cylinder? Why or why not?

Optional verification of formula working for cylinders

1. Apply the formula to the cylinder below.

What is B in the case of a cylinder? _____

Draw a brace to mark h in this cylinder.



Calculated Volume: _____

2. Test out your conjecture by *filling* the container with water and measuring the water in a graduated cylinder (note: Cubic CM are equivalent to ml).

Based upon this evidence, would you say the formula for calculating volume of a rectangular prism also works for a cylinder? Why or why not?



Can you build a better container?

When designing a container, it is important to consider the cost of materials. For the cylinder you built, calculate how much material would be needed (surface area). To do this, calculate the area of the rectangle and the two circles and then find the sum of those three. Record the surface area below.

Surface Area of my container:

Share your surface area with the class.

Study the class data. All containers should have a volume close to 750 cubic cm, but the surface areas are not all the same. Why is it that some cylinders need more material while others need less to hold the same amount?

Your original container was good. You can see from the class data that some may be better, in that they hold the same amount, but use less material (which saves money!). Now, you will try to build the best cylindrical container possible. The “Best” container will have a volume of 750 CC/ML (give or take 10 CC/ML) and will use the LEAST amount of material. Build the shape using cardstock (and beans if you’d like) and then draw a sketch below and record the volume and surface area.

Shape:

Volume:

Surface Area:

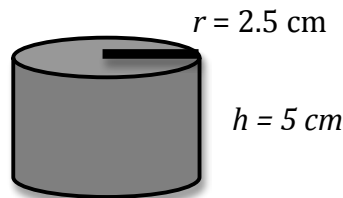


Teacher Directions

Materials:

- Baggies holding 750 ML beans (1 per group of 2-4) Note: You can use a graduated cylinder to measure out the beans.
- Cardstock- approx. 6 sheets per group
- Scissors (1 per student)
- Tape- approx. 10 strips per group
- Calculators (optional)
- Optional Demonstration: Plastic cylinder with radius of 2.5 cm and height of 5 cm and 100 ml of water with a 100 ml graduated cylinder.

Pass out the activity sheet and give the class a minute to recall and record the formula for the volume of a rectangular prism. Note: some students may have learned $v = l \times w \times h$; while correct for a rectangular prism, this formula does not lend itself to further conceptual building with other shapes, and thus the formula $v = Bh$ should be used. If students have no conception of this formula, go back and do the “pre-unit” lesson. Before having students predict, make sure all understand what “ B ” would represent and what “ h ” would be. Draw or put up the following picture and ask them to tell you (or show them) where these variables can be found.



Give students another minute to complete the prediction section. Use think-write-pair share to have students share what they predicted with a partner and then take a quick class poll and record the results.

Go over the directions for “Building a Cylinder and Testing out your formula”. You may wish to show the class how you can make the baggie of beans into a somewhat cylindrical shape and then how you can “wrap” the baggie with cardstock to make the cylinder. Question students to make sure they understand the directions. Put the class in groups of 2-4 and have the materials manager come get the beans, cardstock, scissors and tape. Set the timer for 10 minutes to allow the students to build the cylinder. Once a group is done, give them a ruler and then make sure they records the cylinder in the section “picture of your container) and that they label the radius or diameter and height (to the nearest half-cm).

Once you can see a group has the cylinder built, drawn and labeled correctly, have them complete the section “Calculate Volume”. Here they should be applying the formula $V = Bh$ (use of a calculator is encouraged). Draw the following table on the board (as many rows as you have groups):



| Group | Picture of Cylinder | Radius | Height | Volume | Surface Area |
|-------|---------------------|--------|--------|--------|--------------|
| | | | | | |
| | | | | | |
| | | | | | |

Have each group come record or tell you the information from their cylinder so that all the group's data is on the table (leaving the Surface Area Column Blank).

As group's finish, have them consider the question under the section "comparing class volume" and record their thoughts.

Once you have the class data, have the students turn to page 2 of the activity sheet. Let the class know that every group built a cylinder with a volume of approximately 750 cubic cm. Give the students 5 minutes to silently answer the three questions under the section "Does the formula work for cylinders" and then give the groups 2 minutes to discuss. Randomly call on students to share their thoughts, making sure you end the discussion with students convinced that the formula for the volume of a rectangular prism is the same formula that works to find the volume of a cylinder.

Optional verification of the formula working for cylinders

If you have time and the resources, it might be nice to also show the students a different "experiment" that will allow them to see the formula works. To do so, have the students use the formula $v = Bh$ to calculate the volume of the given cylinder. Then, fill the plastic cylinder with these measurements with water and pour the water into a graduated cylinder to measure. The amount of water should be very close to the calculated volume.

Can you Build a Better Container?

Note: This is somewhat of an extension and can be skipped if needed, but it will prove very helpful for math modeling ideas as well as in solidifying the concept and formula for volume as well as serve as an introduction to surface area.

Have a student read the first paragraph in this section aloud. Question the class to make sure they understand what surface area is and how to calculate it from their net (the cylinder they made on cardstock). Note: if students un-tape the cylinder, it should be relatively easy to calculate surface area. Once each group calculates the surface area, record these numbers of the table on the front board. Give the students 2 minutes to study the data and answer the question, "why is it that some cylinders need more material while others need less to hold the same amount?" Select a few students to share their ideas and then explain the final challenge: the build the best cylinder that will still have a volume of close to 750 cubic cm.

Give groups about 10-15 minutes to build another (or multiple if they have time) cylinder and record the information on the original class table.



Note: The “best” cylinder will have a height equal to the diameter and the proof of this will be addressed in Calculus!

