

11.3

Volume of a Cylinder

GOAL

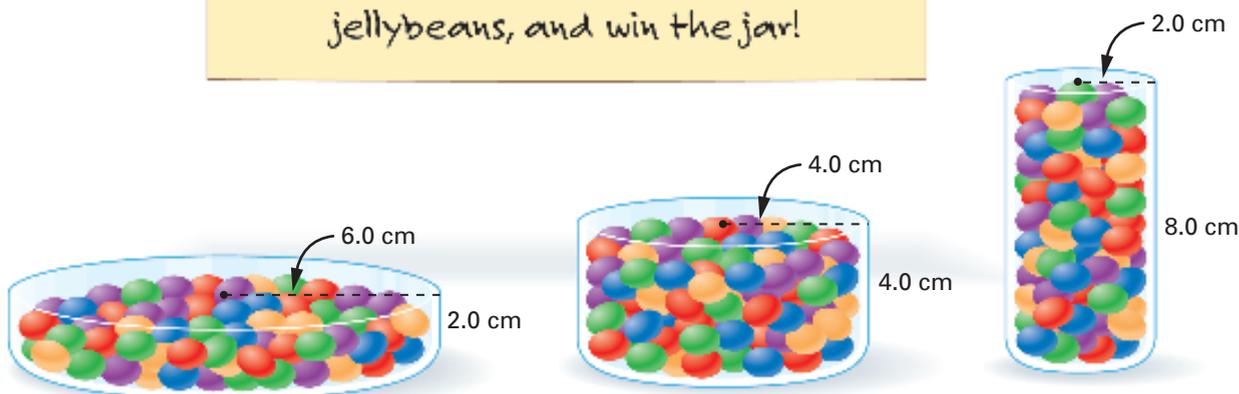
Develop and apply a formula for calculating the volume of a cylinder.

You will need

- centimetre grid paper
- a compass
- centimetre linking cubes
- a calculator

Learn about the Math

Guess which jar holds the most jellybeans, and win the jar!

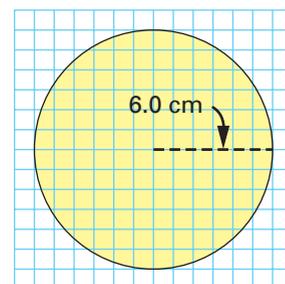


Benjamin says, “The jar with the greatest volume holds the most jellybeans. One jellybean has a volume of about 1 cm^3 . If I can calculate the volume of each jar, I can estimate the number of jellybeans it holds. I’ll use models of the jars to estimate their volumes.

I know that the bottom of each jar is a circle. I’ll estimate the number of centimetre cubes that will cover the bottom. I’ll stack centimetre cubes to determine the number of layers.”

? Which jar holds the most jellybeans?

- On centimetre grid paper, draw a circle with a radius of 6.0 cm to model the base of the first jar. Estimate the area of the base.
- Stack centimetre cubes to model the height of the jar. How many layers of cubes will fit inside the jar?
- Estimate the volume of the first jar.
- Repeat steps A to C for the other two jars.
- Which jar holds the most jellybeans? Explain your answer.



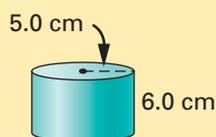
Reflecting

1. Why do both the radius of a cylinder and its height matter when you are estimating its volume?
2. How does Benjamin's strategy show how to use the area of the base of a cylinder to determine the volume of the cylinder?
3. Write a formula for calculating the volume of a cylinder.

Work with the Math

Example 1: Calculating volume using radius

Calculate the volume of this cylinder.



Hoshi's Solution

$$\begin{aligned}\text{Volume of cylinder} &= \text{area of base} \times \text{height} \\ &= \pi r^2 \times \text{height} \\ &\doteq 3.14 \times (5.0 \text{ cm})^2 \times 6.0 \text{ cm} \\ &\doteq 471.0 \text{ cm}^3\end{aligned}$$

The volume of the cylinder is 471.0 cm^3 .

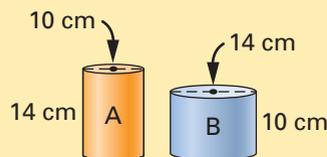
The volume of a cylinder is calculated like the volume of a prism: area of base \times height.

I calculated the volume using the formula and 3.14 for π .



Example 2: Estimating volume using diameter

Estimate which cylinder has the greater volume.



Chad's Solution

Cylinder A

The diameter of cylinder A is 10.0 cm, so the radius is $10.0 \div 2 = 5.0$ cm.

For an estimate, I can use rounded measurements for easier mental math.

$$\begin{aligned}\text{Volume of cylinder A} &= \text{area of base} \times \text{height} \\ &= \pi r^2 \times \text{height} \\ &= \pi \times (5 \text{ cm})^2 \times 14 \text{ cm} \\ &\doteq \pi \times 25 \text{ cm}^2 \times 16 \text{ cm} \\ &\doteq \pi \times 400 \text{ cm}^3\end{aligned}$$

Cylinder B has the greater volume.

Cylinder B

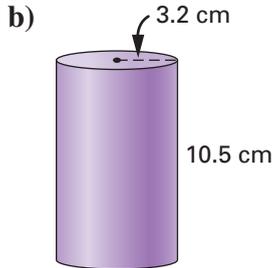
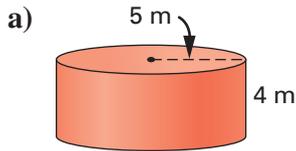
The diameter of cylinder B is 14.0 cm, so the radius is 7.0 cm.

$$\begin{aligned}\text{Volume of cylinder B} &= \text{area of base} \times \text{height} \\ &= \pi r^2 \times \text{height} \\ &= \pi \times (7 \text{ cm})^2 \times 10 \text{ cm} \\ &\doteq \pi \times 50 \times 10 \text{ cm} \\ &\doteq \pi \times 500 \text{ cm}^3\end{aligned}$$

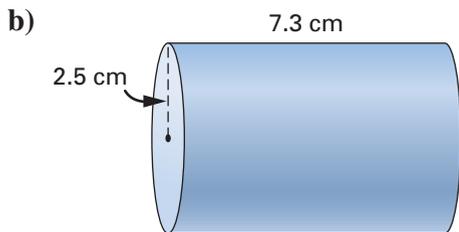
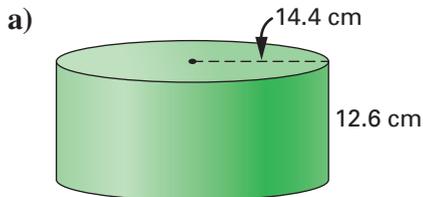


A Checking

4. Estimate the volume of each cylinder.

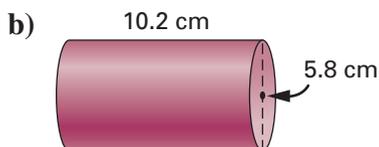
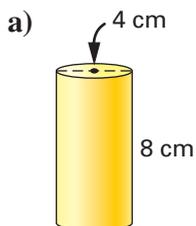


5. Calculate the volume of each cylinder.



B Practising

6. Estimate the volume of each cylinder.

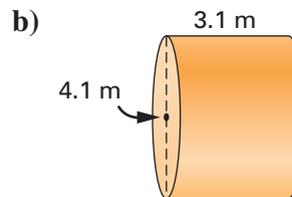
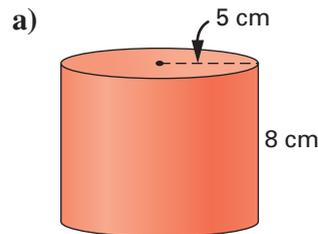


7. a) Determine the volume of Mandy's mug.

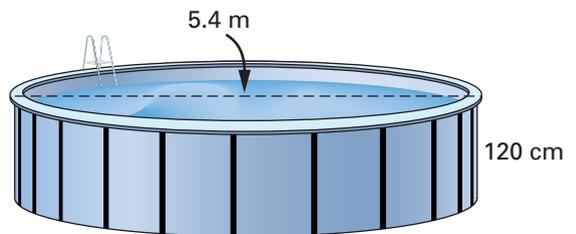
b) About how many millilitres of liquid will it hold?



8. Calculate the volume of each cylinder.



9. Cosmo's family has a pool like this.

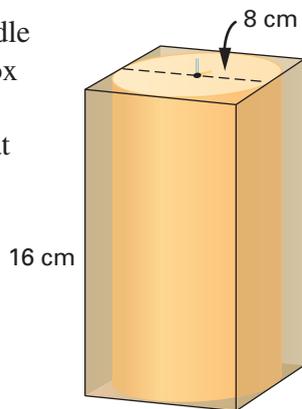


- What is the volume of the pool?
- How many litres of water will the pool hold?
- How long will it take to fill the pool at a rate of 50 L/min?

10. Tennis balls are sold in cylinders. Each cylinder has a height of about 22 cm and a diameter of about 7 cm. Estimate the volume of the cylinder.



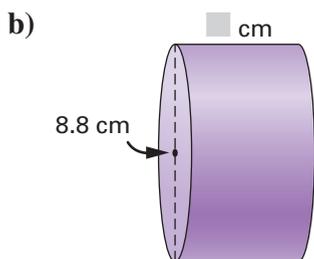
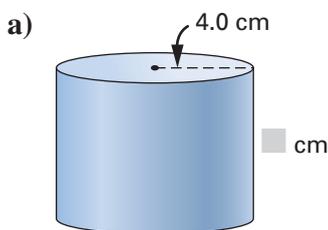
11. A cylindrical candle is sold in a gift box that is a square-based prism. What is the volume of empty space in the box?



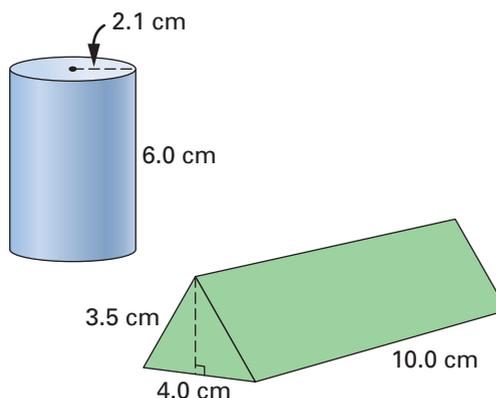
12. Copy and complete this chart for cylinders.

Radius of base	Diameter of base	Height	Volume
4 cm		11 cm	
	12.0 m	5.0 m	
3.5 cm			307.7 cm ³
		2.0 m	226.1 m ³

13. The area of the base of a cylinder is 50.2 cm². The volume of the cylinder is 502.4 cm³. Determine the height of the cylinder.
14. A lipstick tube has a volume of 25.1 cm³ and a diameter of 2.0 cm. What is the height of the tube?
15. The volume of each cylinder below is 0.3040 m³. Solve for the unknown measure.



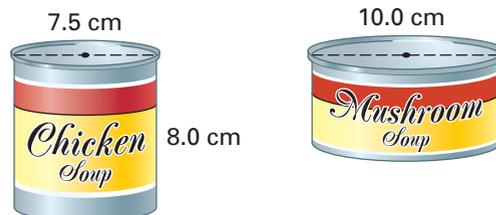
16. Which container holds more, the cylinder or the triangular prism? Justify your answer.



17. Which holds more, a cylinder with a height of 10.0 cm and a diameter of 7.0 cm or a cylinder with a height of 7.0 cm and a diameter of 10.0 cm? Explain your answer.

C Extending

18. These two metal cans both hold the same quantity of soup.



- a) What is the height of the can of mushroom soup? Show your solution.
- b) Which can uses more metal? Explain.
19. Suppose that the radius of a cylinder is the same as its height. What would happen to the volume of the cylinder if its radius were doubled and the height stayed the same?
20. These two containers each hold 1 L of liquid. What might their dimensions be?

