

LESSON

13.2 Volume of Cones



FL 8.G.3.9

Know the formulas for the volumes of cones... and use them to solve real-world and mathematical problems.



ESSENTIAL QUESTION

How do you find the volume of a cone?

EXPLORE ACTIVITY



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Modeling the Volume of a Cone

A **cone** is a three-dimensional figure that has one vertex and one circular base.

To explore the volume of a cone, Sandi does an experiment with a cone and a cylinder that have congruent bases and heights. She fills the cone with popcorn kernels and then pours the kernels into the cylinder. She repeats this until the cylinder is full.

Sandi finds that it takes **3 cones** to fill the volume of the cylinder.

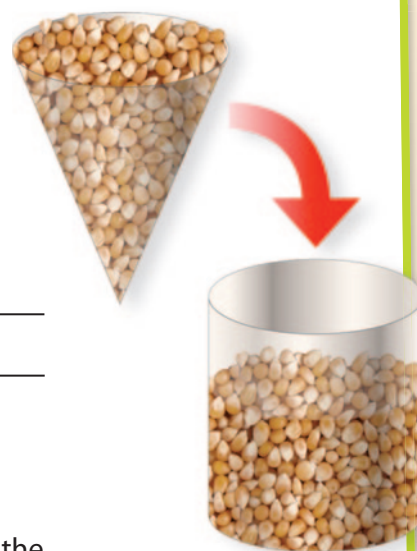
STEP 1 What is the formula for the volume V of a cylinder with base area B and height h ? _____

STEP 2 What is the area of the base of the cone? _____

STEP 3 Sandi found that, when the bases and height are the same, _____ times $V_{\text{cone}} = V_{\text{cylinder}}$.

STEP 4 How does the volume of the cone compare to the volume of the cylinder?

Volume of the cone: $V_{\text{cone}} = \frac{\boxed{}}{\boxed{}} \cdot V_{\text{cylinder}}$



Reflect

1. Use the conclusion from this experiment to write a formula for the volume of a cone in terms of the height and the radius. Explain.

2. How do you think the formula for the volume of a cone is similar to the formula for the volume of a pyramid?



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Finding the Volume of a Cone Using a Formula

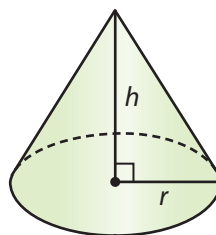
The formulas for the volume of a prism and the volume of a cylinder are the same: multiply the height h by the area of the base B , so $V = Bh$.

In the **Explore Activity**, you saw that the volume of a cone is one third the volume of a cylinder with the same base and height.

Volume of a Cone

The volume V of a cone with radius r is one third the area of the base B times the height h .

$$V = \frac{1}{3} Bh \text{ or } V = \frac{1}{3} \pi r^2 h$$



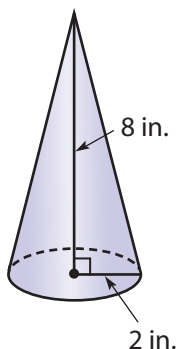
My Notes

EXAMPLE 1



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Find the volume of each cone. Round your answers to the nearest tenth. Use 3.14 for π .

A

$$V = \frac{1}{3} \pi r^2 h$$

$$\approx \frac{1}{3} \cdot 3.14 \cdot 2^2 \cdot 8$$

Substitute.

$$\approx \frac{1}{3} \cdot 3.14 \cdot 4 \cdot 8$$

Simplify.

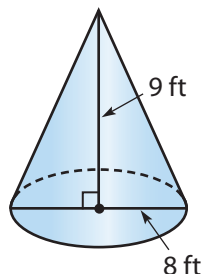
$$\approx 33.5$$

Multiply.

The volume is about 33.5 in^3 .

B

Since the diameter is 8 ft, the radius is 4 ft.



$$V = \frac{1}{3} \pi r^2 h$$

$$\approx \frac{1}{3} \cdot 3.14 \cdot 4^2 \cdot 9$$

Substitute.

$$\approx \frac{1}{3} \cdot 3.14 \cdot 16 \cdot 9$$

Simplify.

$$\approx 150.7$$

Multiply.

The volume is about 150.7 ft^3 .

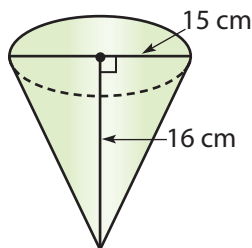
Reflect

3. How can you rewrite the formula for the volume of a cone using the diameter d instead of the radius r ? _____

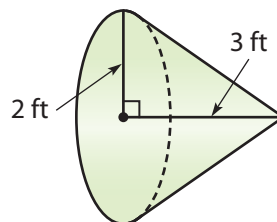
YOUR TURN

Find the volume of each cone. Round your answers to the nearest tenth. Use 3.14 for π .

4.



5.



Finding the Volume of a Volcano

The mountain created by a volcano is often cone-shaped.

EXAMPLE 2



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For her geography project, Karen built a clay model of a volcano in the shape of a cone. Her model has a diameter of 12 inches and a height of 8 inches. Find the volume of clay in her model to the nearest tenth. Use 3.14 for π .

STEP 1

Find the radius.

$$r = \frac{12}{2} = 6 \text{ in.}$$

STEP 2

Find the volume of clay.

$$V = \frac{1}{3} \pi r^2 h$$

$$\approx \frac{1}{3} \cdot 3.14 \cdot 6^2 \cdot 8 \quad \text{Substitute.}$$

$$\approx \frac{1}{3} \cdot 3.14 \cdot 36 \cdot 8 \quad \text{Simplify.}$$

$$\approx 301.44 \quad \text{Multiply.}$$

The volume of the clay is about 301.4 in³.



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YOUR TURN

6. The cone of the volcano Parícutin in Mexico had a height of 410 meters and a diameter of 424 meters. Approximate the volume of the cone.



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Guided Practice

1. The area of the base of a cylinder is 45 square inches and its height is 10 inches. A cone has the same area for its base and the same height. What is the volume of the cone? [\(Explore Activity\)](#)

$$V_{\text{cylinder}} = Bh = \boxed{} \cdot \boxed{} = \boxed{}$$

$$V_{\text{cone}} = \frac{1}{3} V_{\text{cylinder}}$$

$$= \frac{1}{3} \boxed{}$$

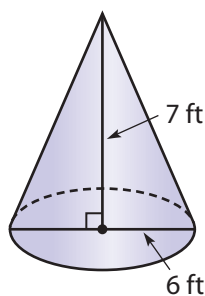
$$= \boxed{}$$

The volume of the cone is $\underline{\hspace{2cm}}$ in³.

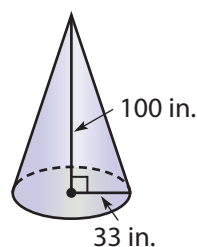
2. A cone and a cylinder have congruent height and bases. The volume of the cone is 18 m³. What is the volume of the cylinder? Explain. [\(Explore Activity\)](#)

Find the volume of each cone. Round your answer to the nearest tenth if necessary. Use 3.14 for π . [\(Example 1\)](#)

3.



4.



5. Gretchen made a paper cone to hold a gift for a friend. The paper cone was 15 inches high and had a radius of 3 inches. Find the volume of the paper cone to the nearest tenth. Use 3.14 for π . [\(Example 2\)](#)
6. A cone-shaped building is commonly used to store sand. What would be the volume of a cone-shaped building with a diameter of 50 meters and a height of 20 meters? Round your answer to the nearest tenth. Use 3.14 for π . [\(Example 2\)](#)



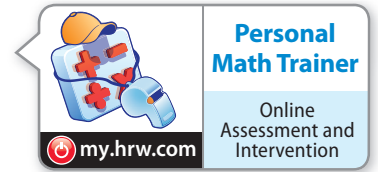
ESSENTIAL QUESTION CHECK-IN

7. How do you find the volume of a cone?

13.2 Independent Practice

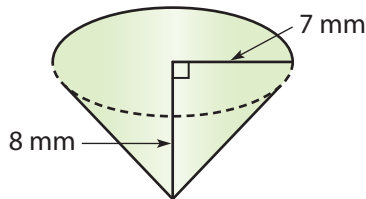


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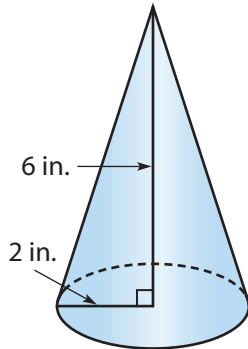


Find the volume of each cone. Round your answers to the nearest tenth if necessary. Use 3.14 for π .

8.



9.



- 10.** A cone has a diameter of 6 centimeters and a height of 11.5 centimeters.

- 11.** A cone has a radius of 3 meters and a height of 10 meters.

Round your answers to the nearest tenth if necessary. Use 3.14 for π .

- 12.** Antonio is making mini waffle cones. Each waffle cone is 3 inches high and has a radius of $\frac{3}{4}$ inch. What is the volume of a waffle cone?

- 13.** A snack bar sells popcorn in cone-shaped containers. One container has a diameter of 8 inches and a height of 10 inches. How many cubic inches of popcorn does the container hold?

- 14.** A volcanic cone has a diameter of 300 meters and a height of 150 meters. What is the volume of the cone?

- 15. Multistep** Orange traffic cones come in a variety of sizes. Approximate the volume, in cubic inches, of a traffic cone that has a height of 2 feet and a diameter of 10 inches. Use 3.14 for π .

Find the missing measure for each cone. Round your answers to the nearest tenth if necessary. Use 3.14 for π .

- 16.** radius = _____

height = 6 in.

volume = 100.48 in³

- 17.** diameter = 6 cm

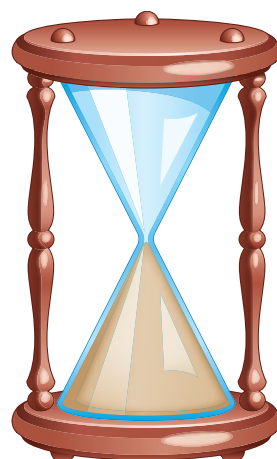
height = _____

volume = 56.52 cm³

- 18.** The diameter of a cone-shaped container is 4 inches, and its height is 6 inches. How much greater is the volume of a cylinder-shaped container with the same diameter and height? Round your answer to the nearest hundredth. Use 3.14 for π .

**FOCUS ON HIGHER ORDER THINKING**

Work Area



19. Alex wants to know the volume of sand in an hourglass. When all the sand is in the bottom, he stands a ruler up beside the hourglass and estimates the height of the cone of sand.

- a. What else does he need to measure to find the volume of sand?

- b. **Make a Conjecture** If the volume of sand is increasing at a constant rate, is the height increasing at a constant rate? Explain.

20. **Problem Solving** The diameter of a cone is x cm, the height is 18 cm, and the volume is 301.44 cm^3 . What is x ? Use 3.14 for π .

21. **Analyze Relationships** A cone has a radius of 1 foot and a height of 2 feet. How many cones of liquid would it take to fill a cylinder with a diameter of 2 feet and a height of 2 feet? Explain.

22. **Critique Reasoning** Herb knows that the volume of a cone is one third that of a cylinder with the same base and height. He reasons that a cone with the same height as a given cylinder but 3 times the radius should therefore have the same volume as the cylinder, since $\frac{1}{3} \cdot 3 = 1$. Is Herb correct? Explain.
