Volume of Prisms and Cylinders

Finding the Volume of a Prism

A
Use centimeter cubes to build a prism like the one shown. Each cube represents a unit of measure called a cubic unit, so centimeter cubes represent cubic centimeters.

Step 1: Find the volume of the prism. Count the number of cubes that make up the prism.

The volume of the prism is \( \text{cm}^3 \).

Step 2: Find the area of the base by counting the number of cubes that make up the face of the top or bottom of the prism.

The area of the base is \( \text{cm}^2 \).

Step 3: Find the height of the prism.

The height of the prism is \( \text{cm} \).

Do you see a relationship between the volume and the area of the base and the height of the prism?

B
Following the steps in A, find the volume, area of the base, and height of the given prism.

Volume: \( \text{cm}^3 \)

Area of the base: \( \text{cm}^2 \)

Height of the prism: \( \text{cm} \)

Do you see a relationship between the volume and the area of the base and the height of the prism?

REFLECT

1. **Conjecture** Based on your discoveries in A, describe in words a way to find the volume of any prism.
You can find the volume of any prism by multiplying the area of the base $B$ by the height of the prism $h$.

**Volume of a Prism**

The volume $V$ of a prism is the area of its base $B$ times its height $h$.

$$V = Bh$$

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**EXAMPLE 2** Finding the Volume of Prisms

Bradley is setting up two tents. One is the shape of a triangular prism and the other is the shape of a trapezoidal prism. How many cubic feet of space are in each tent?

**A** Find the volume of Tent 1.

$$V = \text{ }$$ Use the formula.

$$V = \left( \frac{1}{2} \cdot \text{ } \right) h$$ The base is a triangle.

$$V = \left( \frac{1}{2} \cdot \text{ } \right) h$$ Substitute for $b$ and $h$ in the base.

$$V = \left( \text{ } \right) (\text{ })$$ Substitute for the height of the prism, $h$.

$$V = \text{ }$$ Multiply.

The volume of Tent 1 is $\text{ }$ ft$^3$.

**B** Find the volume of Tent 2.

$$V = \text{ }$$ Use the formula.

$$V = \left( \frac{1}{2} \cdot \text{ } \right) h$$ The base is a trapezoid.

$$V = \left( \frac{1}{2} \cdot \text{ } \right) h$$ Substitute for $h$, $b_1$, and $b_2$ in the base.

$$V = \left( \text{ } \right) (\text{ })$$ Substitute for the height of the prism, $h$.

$$V = \text{ }$$ Multiply.

The volume of Tent 2 is $\text{ }$ ft$^3$.

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**REFLECT**

2. For a prism that is not a rectangular prism, how do you determine which sides are the bases? For a rectangular prism, how do you determine which sides are the bases?
Finding the Volume of a Composite Solid

Allie has two aquariums connected by a small square prism. Find the volume of the double aquarium.

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**A** Find the volume of each of the larger aquariums.

\[ V = Bh \quad Use \ the \ formula. \]

\[ V = \left( \right) \left( \right) \quad Substitute \ for \ B \ and \ h. \]

\[ V = \quad Multiply. \]

The volume of each end aquarium is \underline{cubic feet}.

**B** Find the volume of the connecting prism.

\[ V = Bh \quad Use \ the \ formula. \]

\[ V = \left( \right) \left( \right) \quad Substitute \ for \ B \ and \ h. \]

\[ V = \quad Multiply. \]

The volume of the connecting prism is \underline{cubic feet}.

**C** Add the volume of each part of the aquarium.

\[ V = + + = \]

The volume of the aquarium is \underline{cubic feet}.

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**REFLECT**

3a. **What If...?** Find the volume of the aquarium if all of the dimensions were doubled. What is the relationship between the original volume and the new volume?

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3b. Find the volume of one of the end aquariums using another pair of opposite sides as the base. Do you still get the same volume? Explain.
Find the volume of each figure.

1.  
   \[ \text{Volume} = \text{length} \times \text{width} \times \text{height} \]
   
2.  
   \[ \text{Volume} = \text{base area} \times \text{height} \]
   
3.  
   \[ \text{Volume} = \text{base area} \times \text{height} \]

4. Pete fills the container shown with sand. How much sand fills the container?

5. Mr. Fowler is building a barn for his farm. The dimensions are shown at right. Find the volume of the entire barn.

6. A movie theater offers popcorn in two different containers for the same price. One container is a rectangular prism with a base area of 36 in\(^2\) and a height of 5 in. The other container is a triangular prism with a base area of 32 in\(^2\) and a height of 6 in. Which container is the better deal? Explain.

7. **Critical Thinking** Can rectangular prisms have different heights and the same volume? Show your work below.
Find the volume of each figure.

1. 2.

3. 4.

5. 6.

7. A jewelry box is shaped like a cube. The box measures 8.2 inches on each side. What is the volume of the jewelry box? Round your answer to the nearest tenth.
Problem Solving

Write the correct answer.

1. A carton measures 3 feet by 2 feet by 2 feet. A machine can fill the carton with packing material in 3 seconds. How long would it take to fill a carton that measures 4 feet by 5 feet by 6 feet?

2. A cubic centimeter holds 1 milliliter of liquid. How many liters of water to the nearest tenth are required to fill a fish tank that is 24 centimeters high, 28 centimeters long, and 36 centimeters wide?

3. Caroline is using bricks to build a post in the shape of a rectangular prism. The post is 3 feet tall, 2 feet wide, and 2 feet long. Each brick is 3 inches by 6 inches by 3 inches. How many bricks does Caroline need?

4. A small gift box that holds a ring is shaped like a cube. The box measures 1.4 inches on each side. What is the volume of the gift box? Round your answer to the nearest tenth.

Choose the letter of the correct answer.

5. The average stone on the lowest level of the Great Pyramid in Egypt was a rectangular prism 5 feet long by 5 feet high by 6 feet deep and weighed 15 tons. What was the volume of the average stone?
   A 1,800 ft³  C 150 ft³
   B 1,800 ft²  D 150 ft²

6. A bricklayer is building a brick rectangular post to anchor a mailbox. The post is 3 feet tall, 2 feet deep, and 2 feet wide. Each brick is 3 inches by 6 inches by 3 inches. How many bricks does he need?
   F 12 bricks  H 197 bricks
   G 54 bricks  J 384 bricks