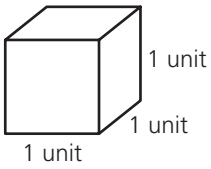
TABLE OF CONTENTS

LESSON
29 Understanding Volume

CCSS: 5.MD.3.a, b; 4

PART 1 Introduction

Volume is a measure of the amount of space an object takes up. It can be measured by finding the number of cubic units it takes to fill the object without overlapping and without spaces between the units. A **cubic unit** is the volume of a cube that has a side length of 1 unit. This type of cube is known as a **unit cube.** It is 1 unit wide, 1 unit long, and 1 unit tall.



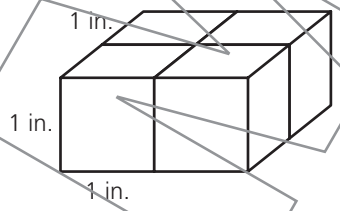
A cube with side lengths measuring 1 unit has a volume of 1 cubic unit, or 1 unit^3.

A cube is a rectangular prism with sides of equal length.

A small box that is 2 inches wide, 2 inches long, and 6 inches tall arrives in the mail. What is the volume of the box in cubic inches?

To find the volume of the box, you can stack unit cubes inside the box. Think of making layers of cubes. One layer has 2 rows of 2 cubes. So there are 4 cubes in a layer. One layer is 4 cubic inches.

The side length of the unit cube can be measured in any unit of length. A side length of 1 centimeter means the volume is 1 cubic centimeter (cm^3).



The box is 6 inches high. So it has 6 layers like the one above. There are 24 cubes in the entire box, so the volume is 24 cubic inches.

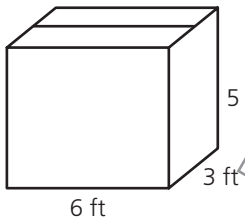
Cubic inches can be written as cubic inches or in.^{3}.

Think About It

Why might it be important to be able to measure the volume of a box used to ship a package?

Work with a partner to build a model using unit cubes to help you understand this volume problem.

➤ Ansel's dad ordered a new chair. The chair was delivered in a box that measured 6 feet long, 3 feet wide, and 5 feet tall. What is the volume of the box?



Build a model of the box using unit cubes.

First, make a row of unit cubes. How many cubes will be in a row? _____

Think of the row as the length of the box.

How many rows of unit cubes are in each layer? _____

How many unit cubes are in each layer? _____

How high is the box?

How many layers of cubes are in the model? _____

Since each layer has the same number of cubes in it, what operation can you use to find the number of cubes in the total number of layers?

_____

Multiply the number of layers by the number of unit cubes in each layer.

_____

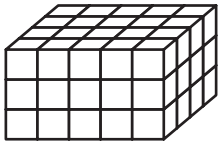
How many unit cubes are there in all? _____

Each unit cube has a volume of 1 cubic foot (1 ft^3).

What is the volume of the box? _____

Count the cubes that make up a rectangular prism to find the volume. You will not be able to see all the cubes.

➤ The rectangular prism below is made up of cubes measuring 1 yard on each edge.



Can you see all the cubes in the figure? _____

How can you tell how many cubes are in the figure?

_____

How can you tell what cubes are hidden behind others?

What is the volume of each unit cube? _____

How many unit cubes are in the bottom layer of the prism? _____

How many layers are in the model? _____

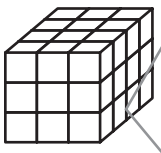
Multiply the number of layers by the number of unit cubes in each layer.

_____

How many unit cubes are there in all? _____

What is the volume of the rectangular prism? _____

Use what you know about volume to find the volume of these objects.

1 

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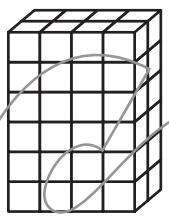
2 

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Solve the following problems.

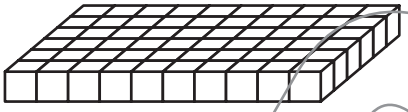
1 A closet is 5 feet wide, 4 feet long, and 7 feet tall. Explain how to find the volume of the closet using boxes that measure 1 foot on each edge.

Think of the closet in layers. What is the volume of one layer?

_____

_____

2 A rectangular figure has one layer filled with the cubes shown.



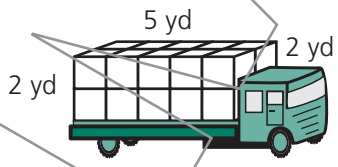
If the figure is 4 units tall, write an expression that can be used to find the volume of the figure.

If the figure is 4 units tall, how many layers like the model shown will the figure have?

Answer _____

3 Luca is packing a truck's cargo section with boxes. Each box is 1 cubic yard. If the truck's cargo section is 2 yards wide by 2 yards high by 5 yards deep, how many boxes can fit?

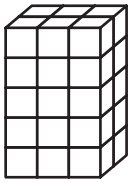
Count the number of boxes measuring 1 cubic yard that can be stacked in each layer.

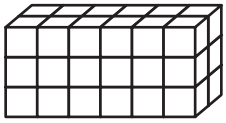


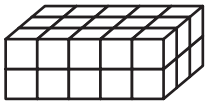
Answer _____ boxes

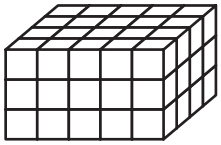
Solve the following problems.

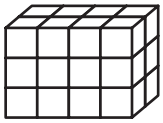
1 Which of these rectangular prisms have a volume of 30 cubic units? Select the **three** correct answers.

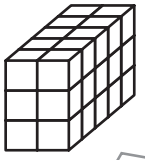
A 

B 

C 

D 

E 

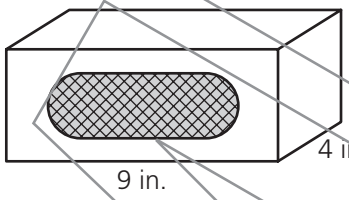
F 

2 A rectangular prism that is 1 centimeter high has a volume of 56 cubic centimeters. If the prism is made up of 7 rows of 1-cubic-centimeter cubes, how many cubes are in each row?

Answer _____ cubes

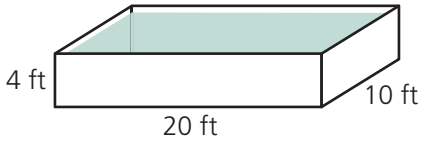
3 Draw a model that can be used to find the volume of a figure with a length of 8 feet, a width of 1 foot, and a height of 3 feet.

4 Cassandra buys a wireless speaker like the one shown.



Draw a model with unit cubes that can be used to find the volume of the speaker.

5 Giles is filling a rectangular swimming pool with water. A side of the pool is 20 feet long, another side is 10 feet long, and the depth of the pool is 4 feet.



Explain how Giles can find the volume of the pool using a model and cubic units.

_____

_____

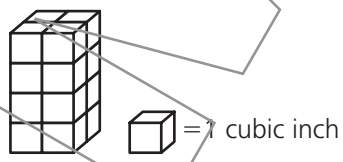
_____

6 Faith had 16 crates that measure 1 cubic foot each. She stacked them to form a rectangular prism.

Part A What was the volume of the prism Faith made with all the crates?

Answer _____ cubic feet

Part B Explain whether or not the figure below has the same volume as Faith's prism.



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