

Introduction to Volume

INSTRUCTIONAL GUIDE

Objective: Students will find volume of rectangular prisms through the layering method.

CCSS.5.MD.C.4: Measure volume by counting unit cubes by using cubic cm, cubic in., cubic ft., and improvised units.

Lesson Components

Opening

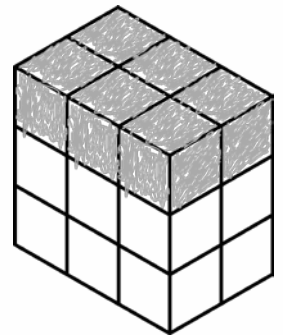
- What does it mean to be three-dimensional? How is a 3-D movie different from a regular movie?
- Volume is what we use to measure anything that takes up space, or anything 3-D.
- You can find the volume of big things like a house or a building, or very small things like a jewelry box or a cell phone.
- No matter what you're measuring, volume is always measured in cubes.

Key Points

- Volume is measured in cubic units. The unit depends on the size of what you're measuring- it might be cubic centimeters or it might be cubic miles.
- You can find the volume of a rectangular prism by counting the number of cubes on the top layer and then multiplying by how many layers there are.
- Whenever you find volume, it is important to include a cubic unit with your answer.

Misconceptions and Tips

- One of the biggest pieces of today's lesson is building an understanding around cubic units. Don't let kids skip writing a unit on their answers and I would avoid switching to shorthand (cm^3 or in^3) until kids are consistently saying "cubic centimeters" and "cubic inches".
- When having kids use the layering method make sure they shade the entire cube of the top layer (sides included) and not just the flat squares on top. It's important that kids visualize each unit as a cube.
- Look out for kids who count the same cube twice. A student who struggles with spatial reasoning might count 9 or even 11 for the image on the right. They are counting the sides as a separate cube from the top. Using manipulatives can be helpful for these students.
- Tell kids to think of floors or stories in a building. "How many cubes are on the top floor?" Six. And "How many floors are there?" Three.



Partner Practice

- This page is designed for students to solve in partners or small groups.
- Go over problems from this section before they start Independent Practice.

Independent Practice/Challenge

- These problems are designed for students to complete at their own pace. Not everyone will complete all 4 pages, as they get progressively more difficult.

Exit Quiz

- This is your chance to see if your students mastered the concept.
- Should be done independently.
- This could count as your daily mastery grade.

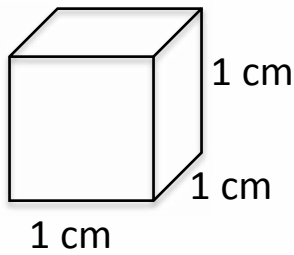
INTRODUCTION TO VOLUME

NAME: _____

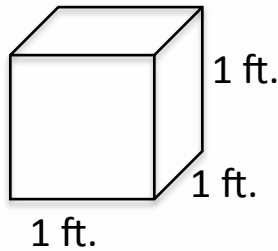
Volume measures the amount of space inside a solid object.

Because solid objects have a length, width, and height they are considered **three-dimensional**. Flat shapes are two-dimensional because they only have a length and width.

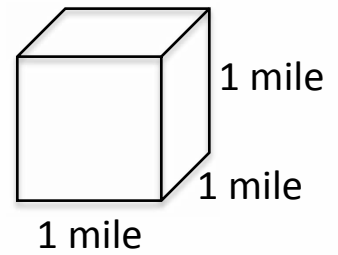
Volume of any solid object, from a jewelry box to a skyscraper, is measured in cubes, known as **cubic units**. The unit will change depending on what you're measuring.



one cubic centimeter

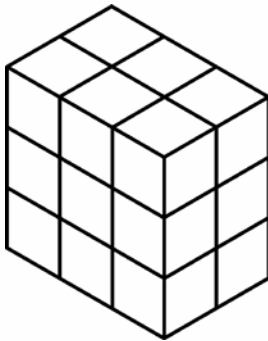


one cubic _____



one _____

Example #1: India built a tower out of cubic centimeters, shown below. What is the volume of India's tower?



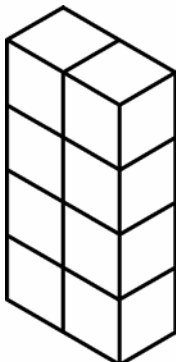
Step 1: Shade cubes on top. How many cubes? _____

Step 2: Count the layers. How many layers? _____

Step 3: Multiply cubes by layers: _____

Volume: _____

Example #2: The figure below was built out of cinder blocks measuring 1 foot on each edge. Find the volume.



Step 1: Shade cubes on top. How many cubes? _____

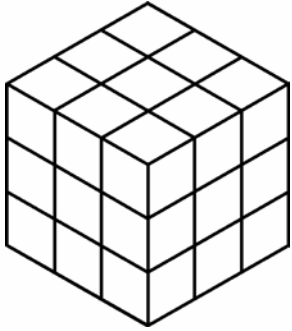
Step 2: Count the layers. How many layers? _____

Step 3: Multiply cubes by layers: _____

Volume: _____

PARTNER PRACTICE

- 1) Jack built a tower out of blocks. Each block is a cubic inch. What is the volume of Jack's tower?



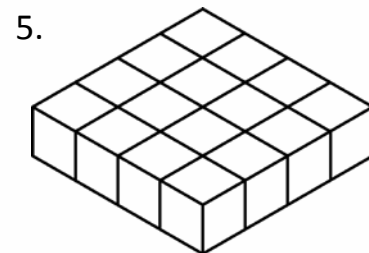
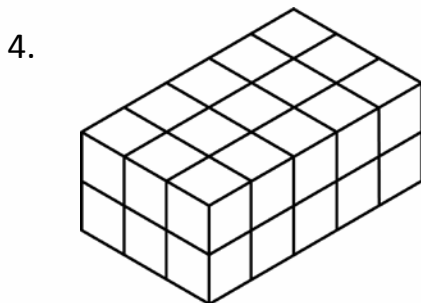
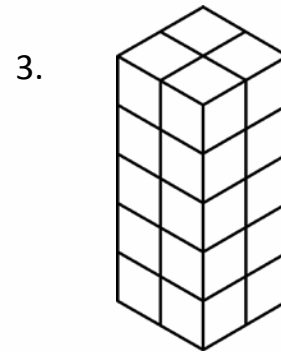
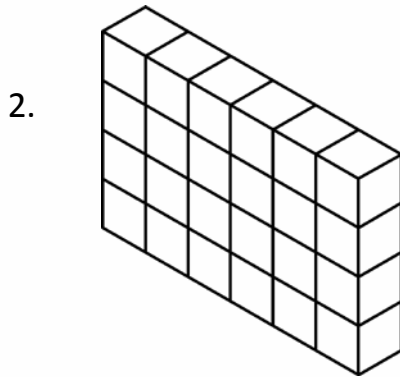
Step 1: Shade cubes on top. How many cubes? _____

Step 2: Count the layers. How many layers? _____

Step 3: Multiply cubes by layers: _____

Volume: _____

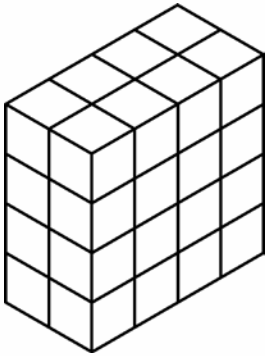
Jack used his blocks to build four more towers. Use the layering method to find the volume of each one. Remember that each cube measures one inch on each side.



6. Martha stacked bricks in her backyard in the shape of a rectangular prism. The bricks measured 1 foot on each side. Martha stacked exactly 24 bricks. What is the volume?
7. Simon was playing with blocks measuring 1 inch on each side. He had exactly 40 blocks. After he built a tower he had 8 blocks leftover. What was the volume of Simon's tower?

INDEPENDENT PRACTICE

1) The cubes in the tower below measures one meter on each edge. Find the volume.



Step 1: Shade cubes on top. How many cubes? _____

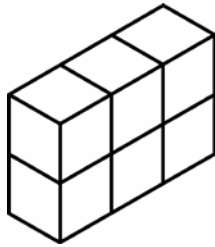
Step 2: Count the layers. How many layers? _____

Step 3: Multiply cubes by layers: _____

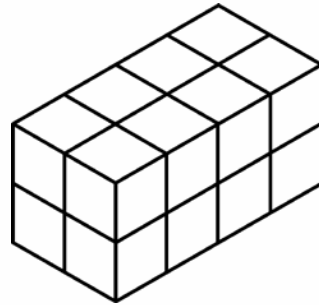
Volume: _____

Use the layering method from question one to find the volume of each tower below. These cubes also measure one meter on each edge.

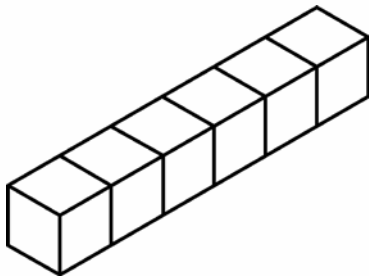
2.



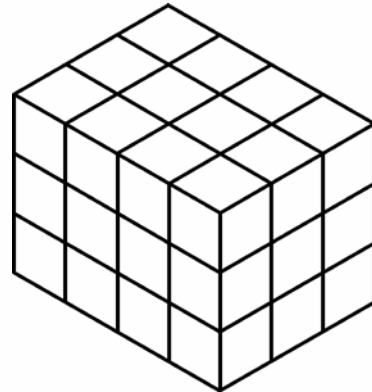
3.



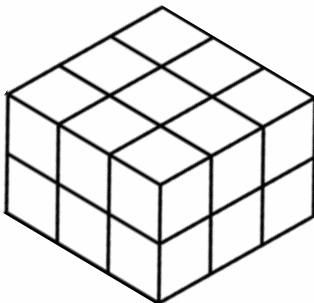
4.



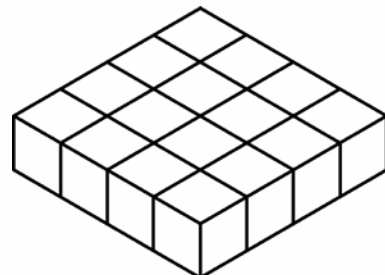
5.



6.

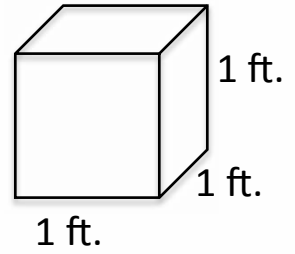


7.

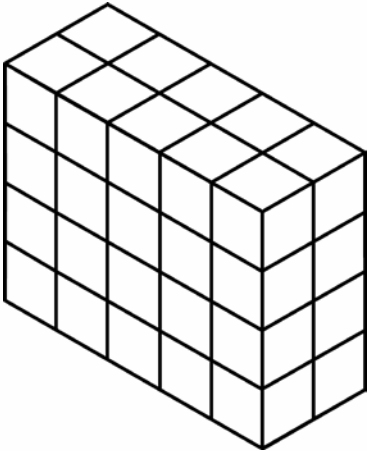


INDEPENDENT PRACTICE

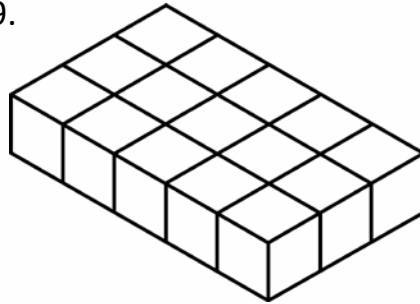
Each of the towers below was built out of unit cubes like the one shown here. Find the volume of each tower in cubic feet.



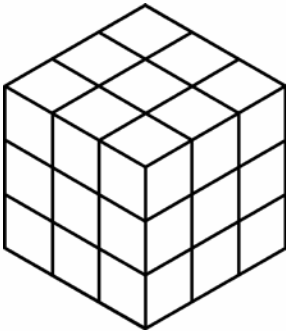
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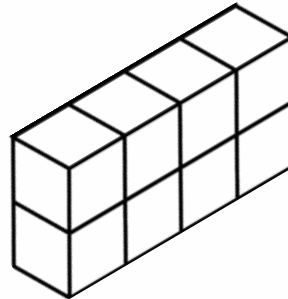
9.



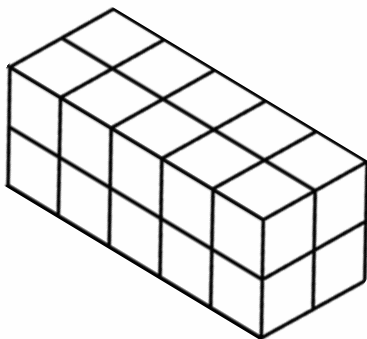
10.



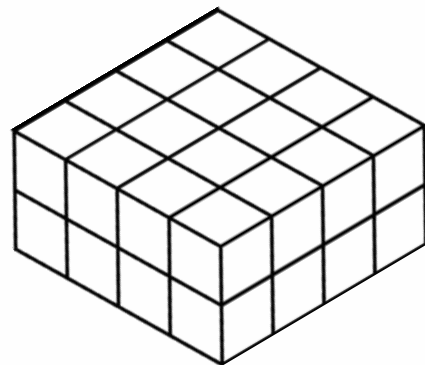
11.



12.



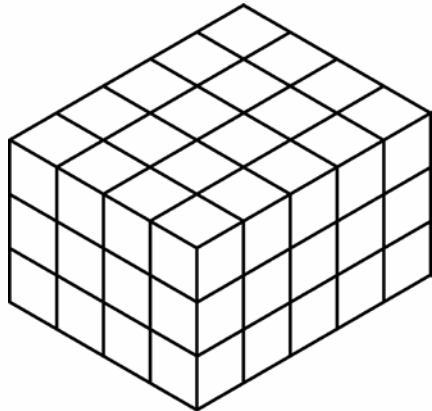
13.



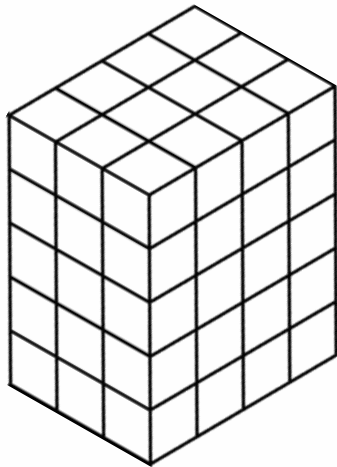
INDEPENDENT PRACTICE

14. Marc bought a puzzle built out of cubes that measure one cubic inch.

A. Find its volume using the layering method.



B. Marc rotated his puzzle so that a different layer is on top. Does it still have the same volume? Why or why not? Show your work.



15. Frances made a pile out of plastic boxes that measure 1 yard on each edge.

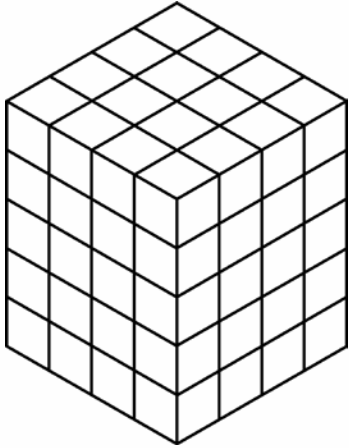
A. If there are 16 boxes in her pile, what is the volume?

B. Frances took 7 of the boxes and used them as shipping containers. She stacked the remaining boxes. What is the volume of her new stack?

CHALLENGE

Gerald has a set of blocks shown below. Each block is a cubic inch.

- A. Find the volume of all of Gerald's blocks.



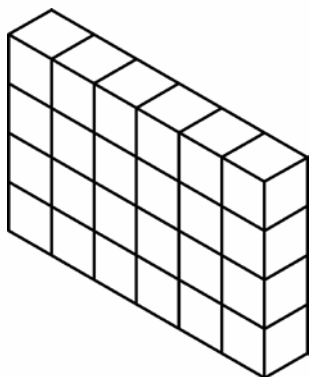
- B. Gerald gives his sister Grace half of his blocks and builds a tower with the remaining blocks. How many blocks does Gerald have left?
- C. Gerald takes the remaining blocks and builds a different tower. What could the tower look like? How many blocks are on the top layer? How many layers are there?
- D. Grace takes her blocks and builds two identical towers. What is the volume of each tower? What could the towers look like? How many blocks on the top layer? How many layers?

EXIT QUIZ: INTRODUCTION TO VOLUME

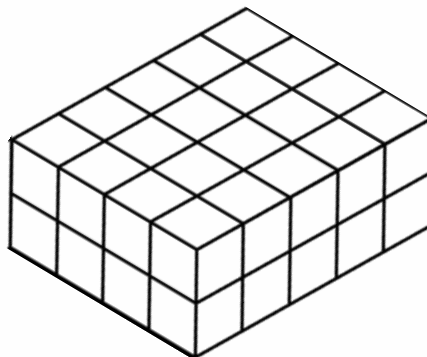
NAME: _____

Use the layering method to find the volume of each tower shown below. The cubes used to build these towers measure one centimeter on each edge.

1.



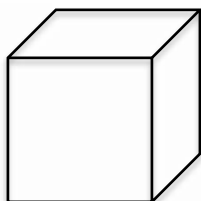
2.



3. Stephen works for a company that sells large foam dice. The foam dice measure 1 foot on each edge. Stephen would also like to sell a storage container to hold a set of 16 dice. What does the volume of Stephen's storage container need to be in order to hold all the dice?

BONUS

Lucy built a box in the shape of a cube, shown below. She plans to use it to hold hats and gloves by her front door. The box measures 2 feet on each edge. Find the volume of Lucy's box.



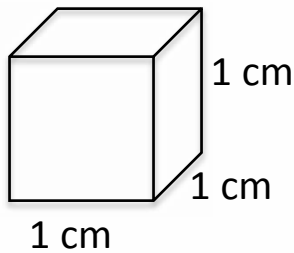
INTRODUCTION TO VOLUME

ANSWER KEY

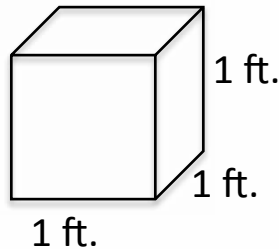
Volume measures the amount of space inside a solid object.

Because solid objects have a length, width, and height they are considered **three-dimensional**. Flat shapes are two-dimensional because they only have a length and width.

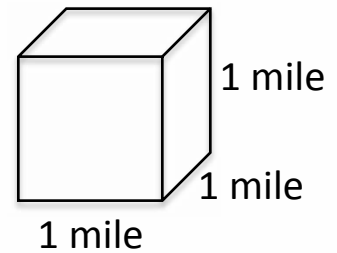
Volume of any solid object, from a jewelry box to a skyscraper, is measured in cubes, known as **cubic units**. The unit will change depending on what you're measuring.



one cubic centimeter

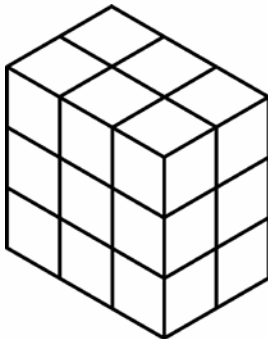


one cubic foot



one cubic mile

Example #1: India built a tower out of cubic centimeters, shown below. What is the volume of India's tower?



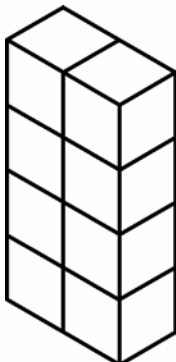
Step 1: Shade cubes on top. How many cubes? 6

Step 2: Count the layers. How many layers? 3

Step 3: Multiply cubes by layers: $6 \times 3 = 18$

Volume: 18 cubic cm

Example #2: The figure below was built out of cinder blocks measuring 1 foot on each edge. Find the volume.



Step 1: Shade cubes on top. How many cubes? 2

Step 2: Count the layers. How many layers? 4

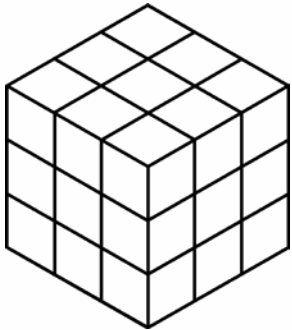
Step 3: Multiply cubes by layers: $2 \times 4 = 8$

Volume: 8 cubic feet

PARTNER PRACTICE

ANSWER KEY

- 1) Jack built a tower out of blocks. Each block is a cubic inch. What is the volume of Jack's tower?



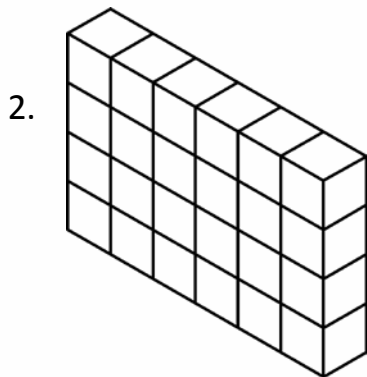
Step 1: Shade cubes on top. How many cubes? 9

Step 2: Count the layers. How many layers? 3

Step 3: Multiply cubes by layers: $9 \times 3 = 27$

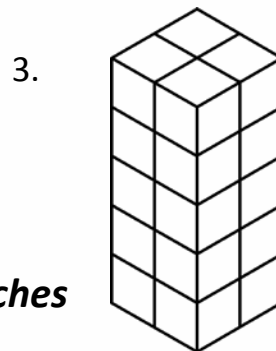
Volume: **27 cubic inches**

Jack used his blocks to build four more towers. Use the layering method to find the volume of each one. Remember that each cube measures one inch on each side.



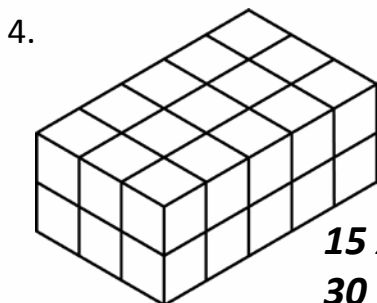
$$6 \times 4 = 24$$

24 cubic inches



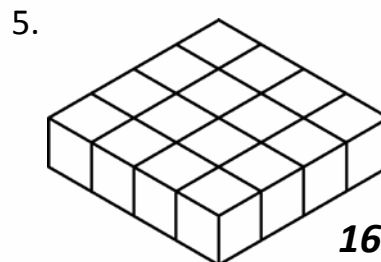
$$4 \times 6 = 24$$

24 cubic inches



$$15 \times 2 = 30$$

30 cubic inches



$$16 \times 1 = 16$$

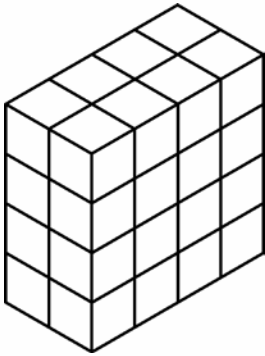
16 cubic inches

6. Martha stacked bricks in her backyard in the shape of a rectangular prism. The bricks measured 1 foot on each side. Martha stacked exactly 24 bricks. What is the volume?
24 cubic feet
7. Simon was playing with blocks measuring 1 inch on each side. He had exactly 40 blocks. After he built a tower he had 8 blocks leftover. What was the volume of Simon's tower?
 $40 - 8 = 32$ cubic inches

INDEPENDENT PRACTICE

ANSWER KEY

- 1) The cubes in the tower below measures one meter on each edge. Find the volume.



Step 1: Shade cubes on top. How many cubes? 8

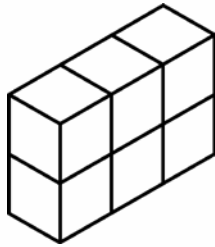
Step 2: Count the layers. How many layers? 4

Step 3: Multiply cubes by layers: $8 \times 4 = 32$

Volume: **32 cubic meters**

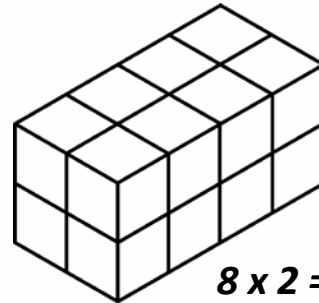
Use the layering method from question one to find the volume of each tower below. These cubes also measure one meter on each edge.

2.



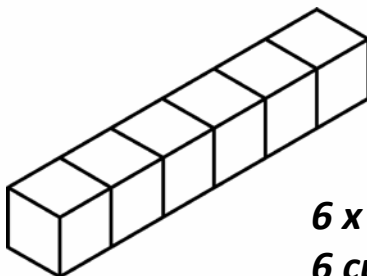
$3 \times 2 = 6$
6 cubic meters

3.



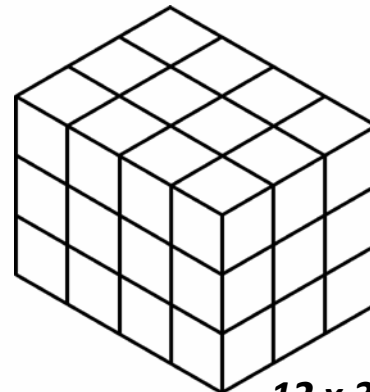
$8 \times 2 = 16$
16 cubic meters

4.



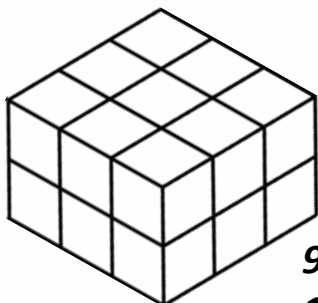
$6 \times 1 = 6$
6 cubic meters

5.



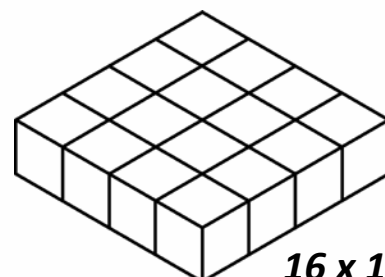
$12 \times 3 = 36$
36 cubic meters

6.



$9 \times 2 = 18$
18 cubic meters

7.

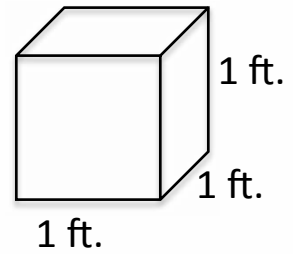


$16 \times 1 = 16$
16 cubic meters

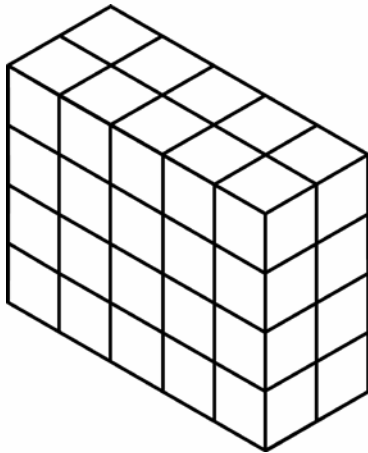
INDEPENDENT PRACTICE

ANSWER KEY

Each of the towers below was built out of unit cubes like the one shown here. Find the volume of each tower in cubic feet.



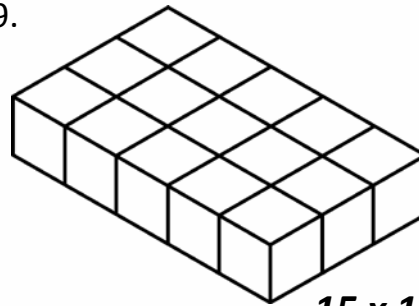
8.



$$10 \times 4 = 40$$

40 cubic feet

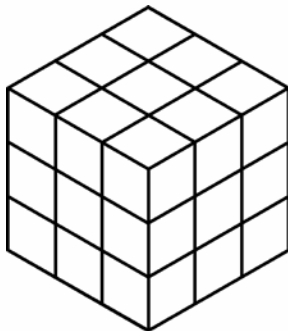
9.



$$15 \times 1 = 15$$

15 cubic feet

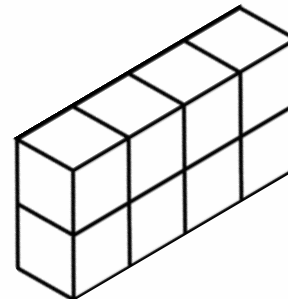
10.



$$9 \times 3 = 27$$

27 cubic feet

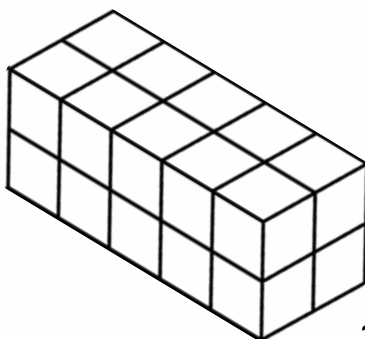
11.



$$4 \times 2 = 8$$

8 cubic feet

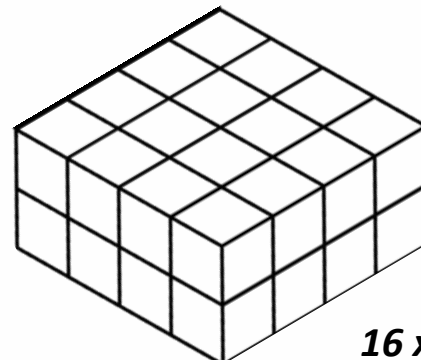
12.



$$10 \times 2 = 20$$

20 cubic feet

13.



$$16 \times 2 = 32$$

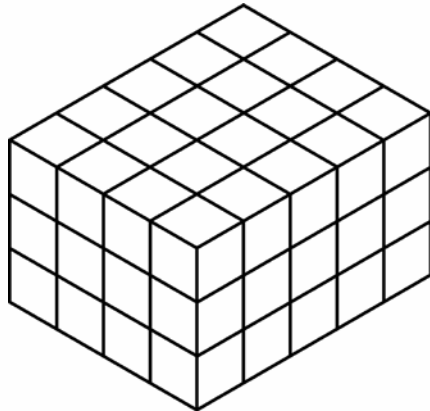
32 cubic feet

INDEPENDENT PRACTICE

ANSWER KEY

14. Marc bought a puzzle built out of cubes that measure one cubic inch.

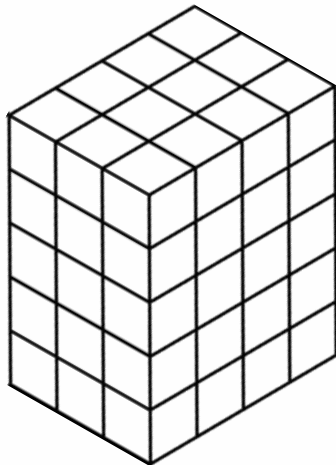
A. Find its volume using the layering method.



$$20 \times 3 = 60$$

60 cubic inches

B. Marc rotated his puzzle so that a different layer is on top. Does it still have the same volume? Why or why not? Show your work.



$$12 \times 5 = 60$$

60 cubic inches

The volume stayed the same because the number of cubes didn't change, he's just looking at the puzzle from a different direction.

15. Frances made a pile out of plastic boxes that measure 1 yard on each edge.

A. If there are 16 boxes in her pile, what is the volume?

16 cubic yards

B. Frances took 7 of the boxes and used them as shipping containers. She stacked the remaining boxes. What is the volume of her new stack?

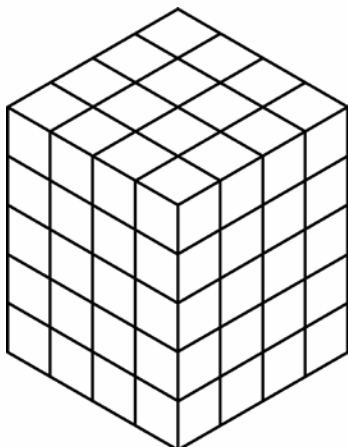
16 - 7 = 9 cubic yards

CHALLENGE

ANSWER KEY

Gerald has a set of blocks shown below. Each block is a cubic inch.

- A. Find the volume of all of Gerald's blocks.



$$16 \times 5 = 80$$

80 cubic inches

- B. Gerald gives his sister Grace half of his blocks and builds a tower with the remaining blocks. How many blocks does Gerald have left?

40 blocks

- C. Gerald takes the remaining blocks and builds a different tower. What could the tower look like? How many blocks are on the top layer? How many layers are there?

4 layers of 10	2 layers of 20
10 layers of 4	20 layers of 2
5 layers of 8	1 layer of 40
	40 layers of 1

- D. Grace takes her blocks and builds two identical towers. What is the volume of each tower? What could the towers look like? How many blocks on the top layer? How many layers?

Grace would have two towers of 20 blocks.

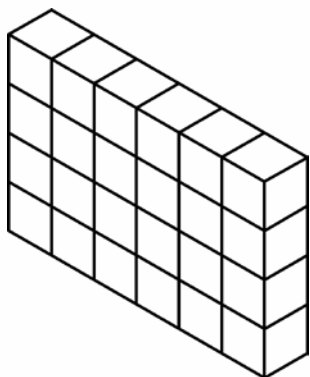
2 layers of 10	20 layers of 1
10 layers of 2	1 layer of 20
5 layers of 4	

EXIT QUIZ: INTRODUCTION TO VOLUME

ANSWER KEY

Use the layering method to find the volume of each tower shown below. The cubes used to build these towers measure one centimeter on each edge.

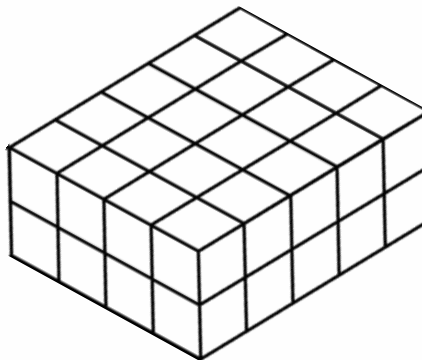
1.



$$6 \times 4 = 24$$

24 cubic cm

2.



$$20 \times 2 =$$

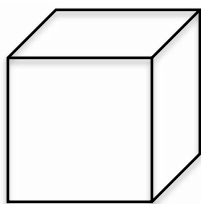
40 cubic cm

3. Stephen works for a company that sells large foam dice. The foam dice measure 1 foot on each edge. Stephen would also like to sell a storage container to hold a set of 16 dice. What does the volume of Stephen's storage container need to be in order to hold all the dice?

The volume of the container needs to be 16 cubic feet.

BONUS

Lucy built a box in the shape of a cube, shown below. She plans to use it to hold hats and gloves by her front door. The box measures 2 feet on each edge. Find the volume of Lucy's box.



$$4 \text{ cubes on top} \times 2 \text{ layers} = 8 \text{ cubic feet}$$