

# Volume Builder Lab

Count unit cubes, connect layers, and add separate volumes.

**GRADE 5 • 5.MD.C**

**CCSS.Math.Content.5.MD.C** "Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition."

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## Materials and setup

Teacher: provide at least 24 same-size unit cubes per pair. Students build, count and sketch in question 1. Each grid square in a layer picture is the top of one unit cube; a single layer picture does not show all layers.

Use stated measurements on prism sketches; they are not drawn to scale. One-centimeter cubes are used whenever lengths are labeled cm.

### CUBES FILL SPACE

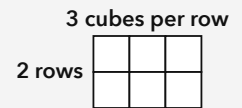
Volume measures space a solid occupies. A unit cube has edge length 1 unit and volume 1 cubic unit. Cubes pack a solid without gaps or overlaps. Each horizontal layer of a rectangular prism has length  $\times$  width cubes. Height tells how many one-unit layers fit. So  $V = l \times w \times h$ . Add volumes of parts that do not overlap.

### WORKED EXAMPLE

This top view shows one full layer of a prism. Each square is the top of a 1-cm cube. The prism has two identical layers. Find its volume.

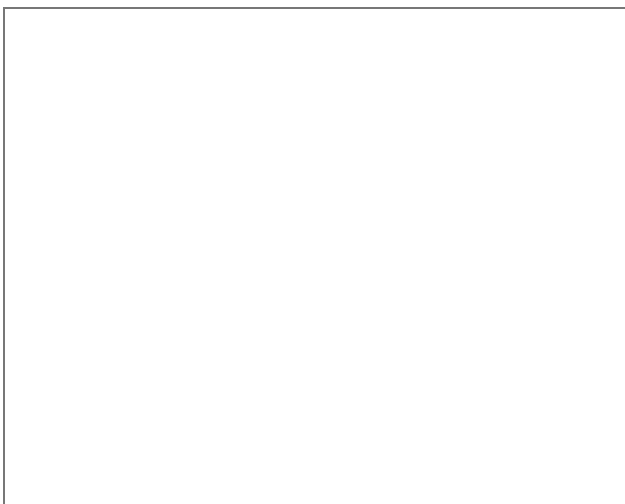
1. One layer has  $2 \times 3 = 6$  unit cubes.
2. Two layers have  $6 + 6 = 12$  cubes.
3. This matches  $3 \times 2 \times 2 = 12$  cubic centimeters.

**Answer: 12 cubic centimeters, not 6: include both layers.**



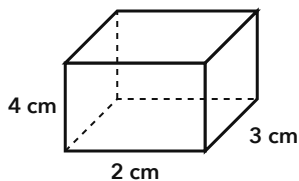
**PRACTICE** 4 problems

- 1** Build a prism with 3 cubes in each row, 2 rows in each layer, and 3 layers. Sketch its layer arrangement. Record cubes per layer, number of layers, total cubes, and volume in cubic units.



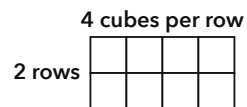
**ANSWER** \_\_\_\_\_  
 \_\_\_\_\_

- 3** Use the prism dimensions. Write a repeated-addition expression for its layers and a multiplication expression for its volume.



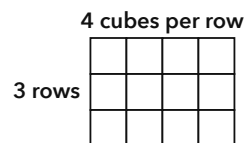
**ANSWER** \_\_\_\_\_  
 \_\_\_\_\_

- 2** The picture shows one layer. A prism has four identical layers. Find cubes per layer and total volume in cubic units. Why is counting only the top squares insufficient?



**ANSWER** \_\_\_\_\_  
 \_\_\_\_\_

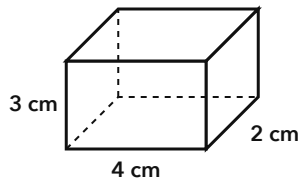
- 4** A prism has volume 36 cubic centimeters. Each layer has 3 rows of 4 one-centimeter cubes. How many layers does it have? What is its height?



**ANSWER** \_\_\_\_\_  
 \_\_\_\_\_

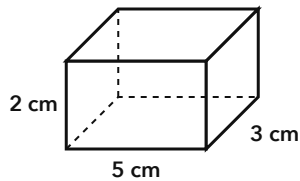
**APPLY IT** Show your work

- 1** Blocks A and B join along a face without overlap. A is 4 cm by 2 cm by 3 cm; B is 2 cm by 2 cm by 3 cm. Find their combined volume by adding. Check it as one 6 cm by 2 cm by 3 cm prism. The diagram shows block A.



**ANSWER** \_\_\_\_\_

- 2** The diagram shows a full starting prism, 5 cm by 3 cm by 2 cm, made of one-centimeter cubes. Six cubes are removed to leave a notch. What volume remains? Why does multiplying the outside dimensions give too much?



**ANSWER** \_\_\_\_\_

## **CHALLENGE** One step up

Two students each use 24 unit cubes. One makes a 6-by-2-by-2 prism; the other makes a 4-by-3-by-2 prism. Do they have equal volume? Explain using layer counts and multiplication.

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WORK SPACE AND ANSWER

**PRACTICE 1**

Build a prism with 3 cubes in each row, 2 rows in each layer, and 3 layers. Sketch its layer arrangement. Record cubes per layer, number of layers, total cubes, and volume in cubic units.

**6 cubes per layer; 3 layers; 18 cubes; 18 cubic units. Sketch shows three equal 3-by-2 layers.**

**PRACTICE 2**

The picture shows one layer. A prism has four identical layers. Find cubes per layer and total volume in cubic units. Why is counting only the top squares insufficient?

**8 cubes per layer;  $8 \times 4 = 32$  cubic units. The top view shows only one of four layers.**

**PRACTICE 3**

Use the prism dimensions. Write a repeated-addition expression for its layers and a multiplication expression for its volume.

**One layer has  $2 \times 3 = 6$  cubes.  $6 + 6 + 6 + 6 = 24$  and  $2 \times 3 \times 4 = 24$  cubic centimeters.**

**PRACTICE 4**

A prism has volume 36 cubic centimeters. Each layer has 3 rows of 4 one-centimeter cubes. How many layers does it have? What is its height?

**12 cubes per layer;  $36 \div 12 = 3$  layers, so height is 3 cm.**

**APPLY IT 1**

$24 + 12 = 36$  cubic centimeters;  $6 \times 2 \times 3 = 36$  cubic centimeters.

A:  $4 \times 2 \times 3 = 24$ . B:  $2 \times 2 \times 3 = 12$ . Their shared face adds no overlapping cubes.

**APPLY IT 2**

24 cubic centimeters remain. Outside dimensions include the six missing cubes. Starting volume is  $5 \times 3 \times 2 = 30$ ; removing six unit cubes leaves  $30 - 6 = 24$ .

**CHALLENGE**

**Yes. Both have 12 cubes per layer and 2 layers:  $6 \times 2 \times 2 = 24$  and  $4 \times 3 \times 2 = 24$  cubic units. Different shapes can have equal volume.**

Observe the actual cube build. Distinguish length from cubic volume units. Layer arrays are top views of one complete one-unit-thick layer. The notch problem shows the full starting prism, not the resulting solid. Use layers to count hidden cubes, not visible faces alone.