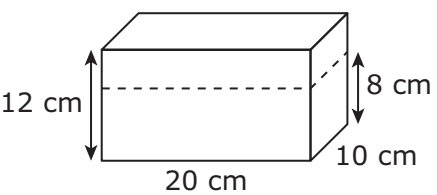
# 9.2c Volume of composite solids

**Objectives**
- Find the volume of composite solids made from nonoverlapping rectangular prisms.
- Solve word problems involving rectangular prisms and the volume of liquids.

**Common Core State Standard**
5.MD.5c

**Mathematical Practices**
MP1
MP2
MP3
MP6

| **Composite solids** | |
|---|---|
| • Refer back to page 64 in the Textbook. Discuss different ways we could find the volume of the solids in A and D using only the measurements of different sides. | |
| • You can have students build similar solids and find different ways to divide them into rectangular parts to find the total volume. Point out that the total volume is the sum of volumes of the parts. | |
| • Draw a tank on the board partially filled with water. Again, have them find the capacity of the tank and the volume of the water in it.<br>• Now ask them to find the volume of water needed to fill the tank completely. Discuss their methods. They could simply subtract the volume of the water already in the tank from the capacity of the tank.<br>• Ask them how they could find the answer without finding the total capacity or the volume of the water already in the tank. They can find the difference in height and use that to find the volume of water needed to fill the tank. |  <br>Capacity = 20 cm × 10 cm × 12 cm<br>= 2,400 $cm^3$<br>Volume of water<br>= 20 cm × 10 cm × 8 cm<br>= 1,600 $cm^3$<br>Water needed to fill the tank:<br>2,400 $cm^3$ − 1,600 $cm^3$<br>= 800 $cm^3$<br>Or<br>20 cm × 10 cm × 4 cm<br>= 800 $cm^3$ |
| • Write the problems on the right on the board and have students find the answer. Discuss their methods. For the first problem, they should realize that the total volume is the sum of the volumes of all the 2-cm cubes. | |
| Method 1:<br>Number of cubes: 10 × 8 × 4 = 320<br>Volume of 1 cube = 2 cm × 2 cm × 2 cm = 8 $cm^3$<br>Total volume = 8 $cm^3$ × 320 = 2,560 $cm^3$<br>Method 2:<br>Dimensions: 10 × 2 cm = 20 cm, 8 × 2 cm = 16 cm, 4 × 2 cm = 8 cm<br>Total volume: 20 cm × 16 cm × 8 cm = 2,560 $cm^3$ | A rectangular prism is made up of 2-cm cubes. Its dimensions are 10 cm by 8 cm by 4 cm. What is its volume? |

- Give students a chance to work on this first and present their solutions. Some may find the total volume and divide by the volume of a 2-cm cube. Ask them why we cannot solve the problem this way.
- If we put a row in the bottom layer, we will get a gap of 1 cm along both the length and width where we cannot fit a whole cube. So we need to first find how many cubes can fit along the length, width, and height.
  $11 \div 2 = 5$ R 1; $9 \div 2 = 4$ R 1.
  Total number of cubes: $5 \times 5 \times 4 = 100$

A rectangular container is 11 cm long, 11 cm wide, and 9 cm high. How many 2-cm cubes can it hold?

## Discussion

## Textbook, pp. 69–70

- Discuss the three methods shown here. In particular, discuss the third method. Students may not have thought of the third method in the previous activity.

**Answers:**

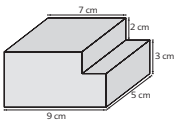
8. Method 1
   Volume = $(7 \times 5 \times 2)$ cm$^3$ + $(9 \times 5 \times 3)$ cm$^3$
   = (**70** + **135**) cm$^3$ = **205** cm$^3$

   Method 2
   Volume = $(7 \times 5 \times 5)$ cm$^3$ + $(2 \times 5 \times 3)$ cm$^3$
   = (**175** + **30**) cm$^3$ = **205** cm$^3$

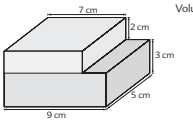
   Method 3
   Volume = $(9 \times 5 \times 5)$ cm$^3$ − $(2 \times 5 \times 2)$ cm$^3$
   = (**225** − **20**) cm$^3$ = **205** cm$^3$

   The volume is 205 cm$^3$.

8. The following solid is made from centimeter cubes. Find the volume.

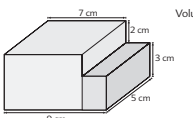



**Method 1:**




Volume = $(7 \times 5 \times 2) + (9 \times 5 \times 3)$
= ☐ + ☐
= ☐ cm$^3$

**Method 2:**




Volume = $(7 \times 5 \times 5) + (2 \times 5 \times 3)$
= ☐ + ☐
= ☐ cm$^3$

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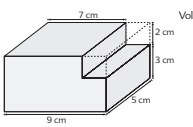
**Method 3:**




Volume = $(9 \times 5 \times 5) - (2 \times 5 \times 2)$
= ☐ − ☐
= ☐ cm$^3$

## Assessment

## Textbook, pp. 70–71

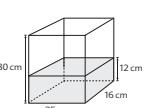
**Answers:**

9. (a) 4,800
   (b) 7,200
   (c) 12,000
10. (a) 18,000
    19,200
    37,200
    (b) Answers will vary. Students can form two different parts, or use Method 3 above.

9. A rectangular tank measuring 25 cm by 16 cm by 30 cm is filled with water to a depth of 12 cm.

(a) Find the volume of water in the tank.

Volume of water = 25 × 12 × 16
= ☐ cm$^3$




(b) How much more water is needed to fill the tank?

Increase in height of water level = 30 − 12
= 18 cm

Volume of water needed = 25 × 16 × 18
= ☐ cm$^3$

(c) What is the total capacity of the container?

Capacity of the container = ☐ cm$^3$

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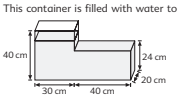
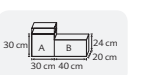
10. This container is filled with water to a depth of 30 cm.




(a) Find the volume of the water in the container.

Volume of water in A = ☐ cm$^3$
Volume of water in B = ☐ cm$^3$
Total volume of water = ☐ cm$^3$

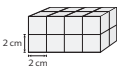



(b) Find another way to calculate the volume.

11. Method 1
8
4
4
128

Method 2
8
128

11. The following solid is made up from 2-cm cubes.
What is it's volume?




**Method 1:**

I find the length of each side first.

Length = ☐ cm
Width = ☐ cm
Height = ☐ cm
Volume = ☐ cm³

**Method 2:**

I find the volume of 1 cube first.

Volume of 1 cube = ☐ cm³

Volume of 16 cubes = ☐ cm³

Exercise 4, pages 51–53

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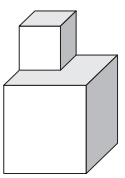
## Practice

## Workbook Exercise 4, pp. 51–53

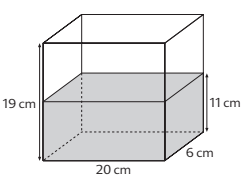
### EXERCISE 4

1. A solid is made up of 2 cubes, one on top of the other. The top cube has sides of 12 cm and the bottom cube has sides of 18 cm. What is the volume of the solid?



**Volume of top cube: 12 cm × 12 cm × 12 cm = 1,728 cm³**
**Volume of bottom cube: 18 cm × 18 cm × 18 cm**
**= 5,832 cm³**
**Total volume: 1,728 cm³ + 5,832 cm³ = 7,560 cm³**
**The volume of the solid is 7,560 cm³.**

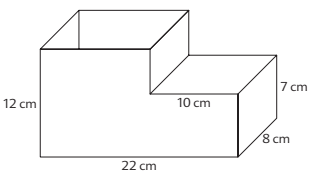
2. Find the volume of water needed to fill the container.




**Height of water needed: 19 cm − 11 cm = 8 cm**
**Volume of water needed: 20 cm × 6 cm × 8 cm**
**= 960 cm³**
**The volume of water needed to fill the container is 960 cm³.**



3. (a) Find the volume of the container.

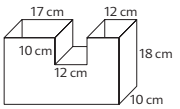



**Length of the top part: 22 cm − 10 cm = 12 cm**
**Height of the top part: 12 cm − 7 cm = 5 cm**
**Volume of the top part: 12 cm × 8 cm × 5 cm = 480 cm³**
**Volume of the bottom part: 22 cm × 8 cm × 7 cm**
**= 1,232 cm³**
**Total volume: 480 cm³ + 1,232 cm³ = 1,712 cm³**
**The volume of the container is 1,712 cm³**

(b) The container in (a) is filled with water to a depth of 10 cm.
What is the volume of water in the container?

**Depth of water in the top part: 10 cm − 7 cm = 3 cm**
**Volume of water in the top part: 12 cm × 8 cm × 3 cm**
**= 288 cm³**
**Volume of water in the bottom part: 1,232 cm³**
**Total volume of water: 288 cm³ + 1,232 cm³**
**= 1,520 cm³**
**The volume of water in the container is 1,520 cm³.**

4. The container shown is filled with water to a depth of 9 cm. How much water does it contain?




**Height of the top part: 18 cm − 10 cm = 8 cm**
**Depth of water in the top part: 9 cm − 8 cm = 1 cm**
**Volume of water in the top left part:**
**17 cm × 10 cm × 1 cm = 170 cm³**
**Volume of water in the top right part:**
**12 cm × 10 cm × 1 cm = 120 cm³**
**Length of the bottom part: 17 cm + 12 cm + 12 cm**
**= 41 cm**
**Height of the bottom part: 18 cm − 10 cm = 8 cm**
**Volume of water in the bottom part:**
**41 cm × 10 cm × 8 cm = 3,280 cm³**
**It contains 3,280 cm³ of water.**

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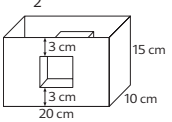
5. A rectangular container has a square hole through its center. It is $\frac{1}{2}$-filled with water. How much water does it contain?




**Height of hole: 15 cm − 3 cm − 3 cm = 9 cm**
**Volume of square hole: 9 cm × 10 cm × 9 cm = 810 cm³**
**Volume of the container: 20 cm × 10 cm × 15 cm − 810 cm³**
**= 2,190 cm³**
**Volume of water: 2,190 cm³ ÷ 2 = 1,095 cm³**
**It contains 1,095 cm³ of water.**