

# Problem Solving with Volume

## INSTRUCTIONAL GUIDE

**Objective:** Students will solve real-life problems involving volume.

**CCSS.5.MD.C.5:** Relate volume to the operations of multiplication and addition and solve real world mathematical problems involving volume.

### Lesson Components

#### Opening

- Just like any unit can be added, subtracted, multiplied, or divided, cubic units can be added, subtracted, multiplied or divided.
- By finding the volume of each box in example #1, we have a common unit- cubic inches and we can add them to find the combined volume.
- Volume can also be multiplied. In example #2, once we find the volume of each cube, we can multiply it by 6.
- In example #3: the dimensions are given to us in meters so we must multiply  $l \times w \times h$  first. Then we have cubic meters and can subtracted from the total.

#### Key Points

- Just like any other unit, cubic units can be added, subtracted, multiplied or divided.
- Before I perform any operation, the units must be the same. I can't add inches and cubic inches because they aren't the same.
- If a problem asks me for volume my answer will be in cubic units. If the problem asks me for one or more dimensions, my answer will have a regular, one-dimensional unit.
- Clues to help us choose the operation, such as "how much greater" or "combined" can still be used to help us in problems concerning volume.

#### Misconceptions and Tips

- Today's lesson is very challenging, because no two problems are alike.
- First, have kids focus on **what** the question is asking them. Am I looking for volume? Am I looking for a dimension? This will help them determine their problem solving plan.
- Encourage kids to use problem solving clues they use in regular word problems to help them determine the operation. If I'm cutting something into equal pieces, this means I'm dividing. If I'm finding the difference, this means subtraction.
- This lesson is a great opportunity to show how a problem can be solved in more than one way. Encourage students to share different methods. Showcase student work under a document camera.
- Be patient with kids! We all know problem solving can't be taught in one lesson. This is an ongoing thing kids need to practice. The purpose of this lesson is to show students how the four basic operations relate to volume. Don't expect every student to get every problem right away!

#### 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.

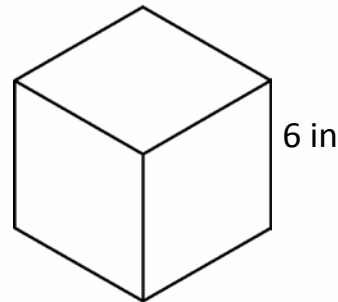
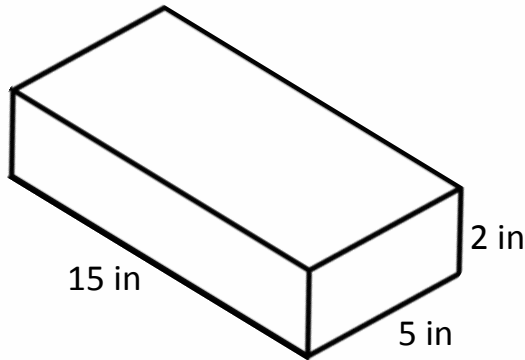
#### Exit Quiz

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

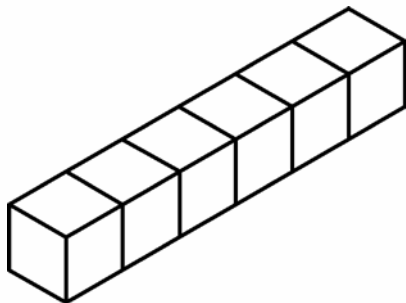
# PROBLEM SOLVING *with Volume*

NAME: \_\_\_\_\_

Example 1: Diana shipped two boxes, shown below. One box is a rectangular prism and the other box is a cube. What is their combined volume?



Example #2: Stan built the figure below out of cinder blocks on the edge of his vegetable garden. The cinder blocks measure 2 feet on each edge. What is the total volume?

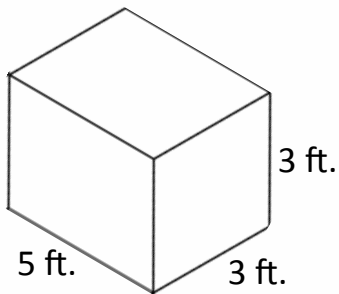


Example #3: A liquid storage plant has two tanks. The tanks have a combined volume 1,080  $\text{m}^3$ . Tank A is 8 meters long, 5 meters wide, and 20 meters deep. What is the volume of Tank B?

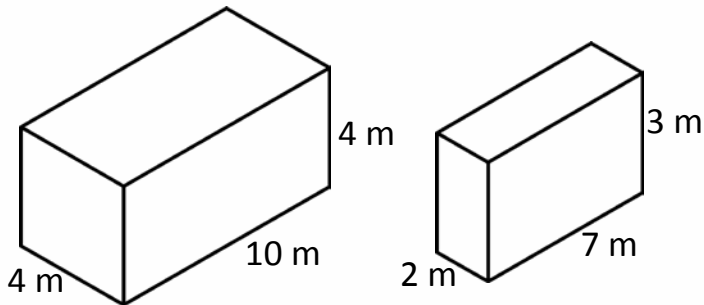
# PARTNER PRACTICE

1. Bethany ordered two containers of tomato paste. One has volume of  $36 \text{ in}^3$  and the other has a volume of  $20 \text{ in}^3$ . How many cubic inches of tomato paste did Bethany order?

2. Grant built five storage bins like the one shown below. How many cubic feet of storage does Grant have?



3. Find the difference in volume between the two figures below.

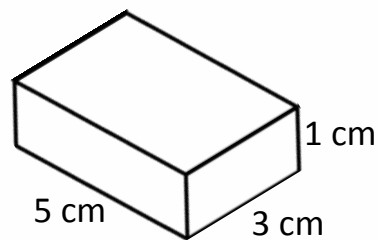
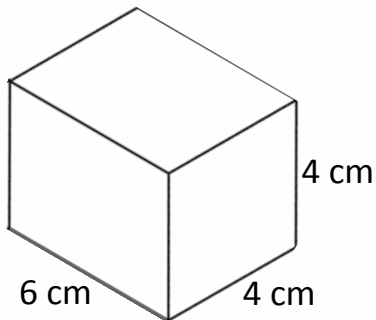


4. Lila has two jewelry box. The larger jewelry box has a volume of  $80 \text{ in}^3$ . The difference in volume between the jewelry boxes is  $20 \text{ in}^3$ . What could be the dimensions of Lila's smaller jewelry box?

# INDEPENDENT PRACTICE

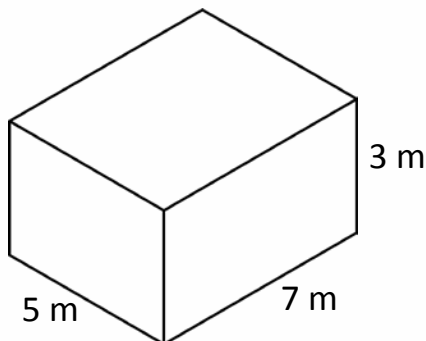
1. John's playroom has two toy bins. One has a volume of  $80 \text{ ft}^3$  and the other has a volume of  $55 \text{ ft}^3$ . Find the difference in volume between these two toy bins.

2. What is the combined volume of the two boxes shown below?



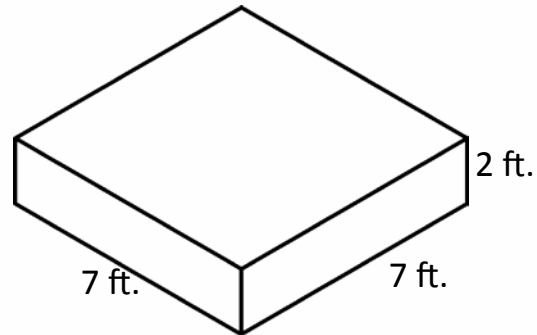
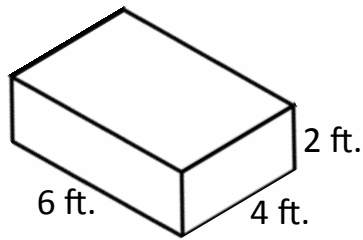
3. Felicity needs a storage container for her block set. The blocks are cubes with a side length of 2 cm. Felicity has 30 blocks. What does the volume of the container need to be?

4. An aquarium has two dolphin tanks with a combined volume of  $850 \text{ yds}^3$ . The smaller of the two dolphin tanks is shown below. What is the volume of the larger dolphin tank?



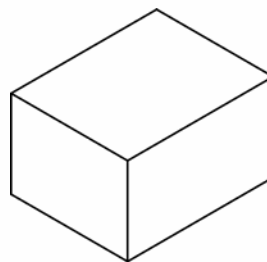
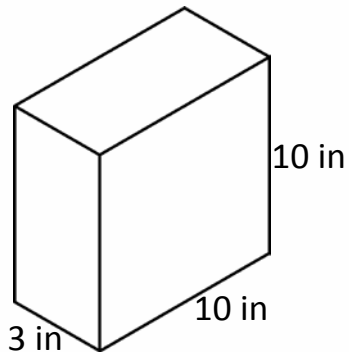
# INDEPENDENT PRACTICE

5. Stella owns a quilting business. She builds two storage containers to hold her quilts. What is the combined volume of the two containers?



6. The trunk of Louise's car has volume of 13 cubic feet. Jack's car has three times as much trunk space as Louise's car. What is volume of the trunk of Jack's car?

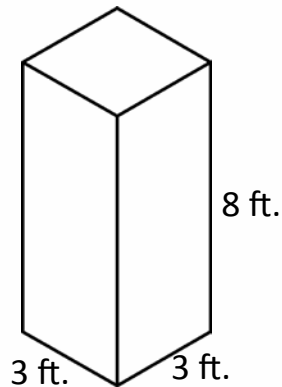
7. The two boxes below have a combined volume of  $500 \text{ in}^3$ . What could be the dimensions of the second box?



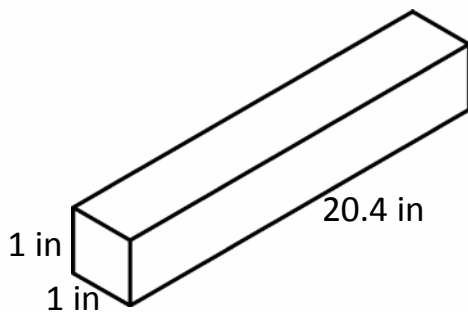
8. A stack of boxes in Mitchell's cupboard have a combined volume of  $1,200 \text{ ft}^3$ . If all 24 boxes have an equal volume, what is the volume of each box?

# INDEPENDENT PRACTICE

9. Dora built a tool shed with a volume that is  $48 \text{ ft}^2$  greater than the toolshed shown below. If the height of Dora's toolshed is the same as the one below, what could the length and width be?

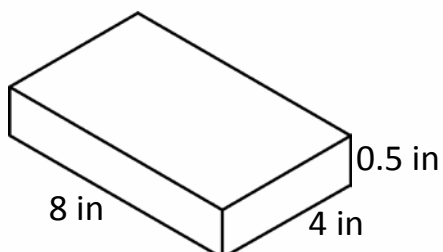


10. Jessica cut the board below into 12 equal pieces. What is the volume of each piece?



11. Joseph paid for  $200 \text{ ft}^3$  of storage space on the cargo hold of a ship. He would like to have two storage containers with equal volume but different dimensions. What could the dimensions be of each storage container?

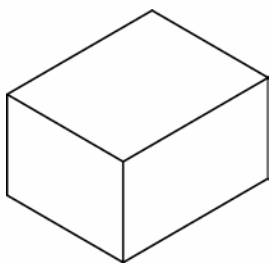
12. Max built a tool box with the same height as the one shown below. The length and width are each two inches longer. How much greater is the volume of Max's toolbox than the one shown below?



# CHALLENGE

1. Container A and Container B have a combined volume of  $600 \text{ cm}^3$ . Container A is twice as big as Container B. What is the volume of each container?

2. The rectangular prism below has a volume of  $64 \text{ ft}^3$ . The length is double the width. The height is half the width. What are the three dimensions?



3. Complete the statement below.

*When I double the dimensions of a rectangular prism, the volume is \_\_\_\_\_ times bigger.*

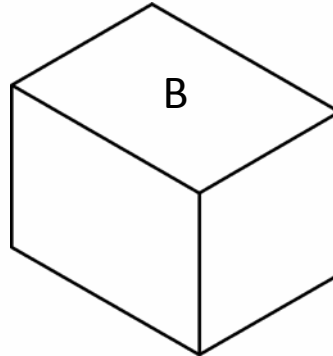
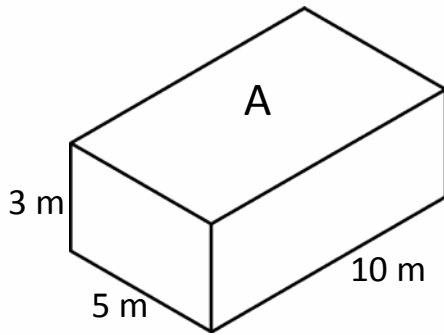
4. Complete the statement below.

*When I triple the dimensions of a rectangular prism, the volume is \_\_\_\_\_ times bigger.*

# EXIT QUIZ: PROBLEM SOLVING WITH VOLUME

NAME: \_\_\_\_\_

1. The combined volume of Box A and Box B is  $240 \text{ m}^3$ . What is the volume of box B?



2. Jonathon built a wall out of concrete bricks. Each brick is a cube with a side length of 3 feet. If Jonathon used 20 bricks to build the wall, what is its volume?

## BONUS

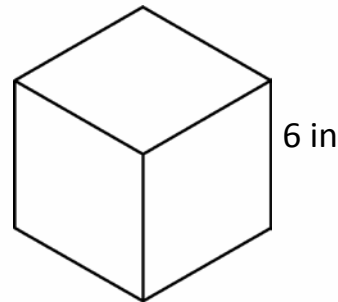
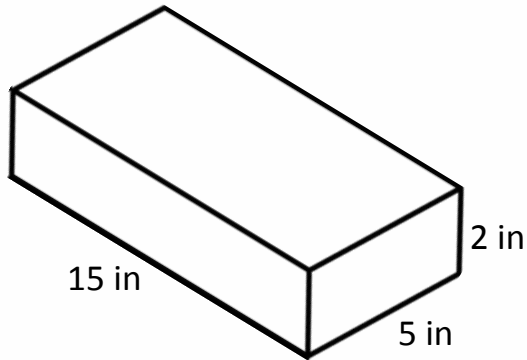
Janice has two boxes she uses to store family photographs. Both boxes have a height of 4 inches, but one box has twice the volume of the other. What could the length and width of each box be?



# PROBLEM SOLVING *with Volume*

NAME: \_\_\_\_\_

Example 1: Diana shipped two boxes, shown below. One box is a rectangular prism and the other box is a cube. What is their combined volume?

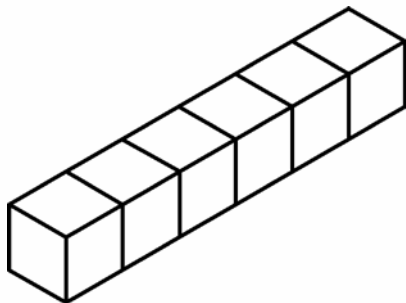


$$15 \times 5 \times 2 = 150$$

$$6 \times 6 \times 6 = 216$$

$$150 + 216 = 366 \text{ in}^3$$

Example #2: Stan built the figure below out of cinder blocks on the edge of his vegetable garden. The cinder blocks measure 2 feet on each edge. What is the total volume?



$$2 \times 2 \times 2 = 8$$

$$8 \times 6 = 48 \text{ ft}^3$$

Example #3: A liquid storage plant has two tanks. The tanks have a combined volume 1,080 m<sup>3</sup>. Tank A is 8 meters long, 5 meters wide, and 20 meters deep. What is the volume of Tank B?

$$8 \times 5 \times 20 = 800$$

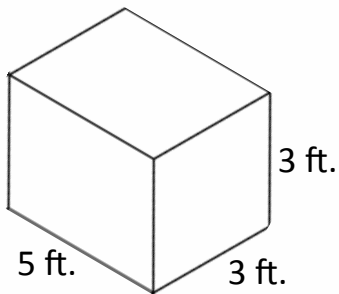
$$1,080 - 800 = 280 \text{ m}^3$$

# PARTNER PRACTICE

1. Bethany ordered two containers of tomato paste. One has volume of  $36 \text{ in}^3$  and the other has a volume of  $20 \text{ in}^3$ . How many cubic inches of tomato paste did Bethany order?

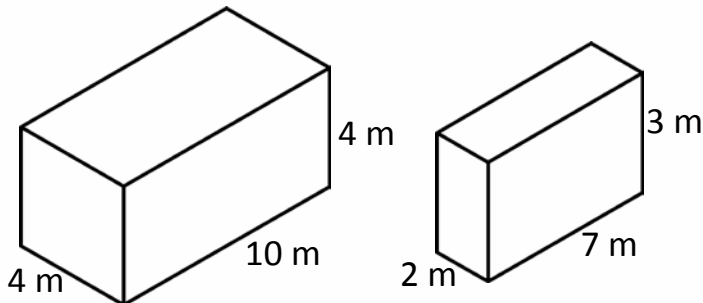
$$20 + 36 = 56 \text{ in}^3$$

2. Grant built five storage bins like the one shown below. How many cubic feet of storage does Grant have?



$$5 \times 3 \times 3 = 45$$
$$45 \times 5 = 225 \text{ ft}^3$$

3. Find the difference in volume between the two figures below.



$$4 \times 10 \times 4 = 160$$
$$2 \times 7 \times 3 = 42$$
$$160 - 42 = 118 \text{ m}^3$$

4. Lila has two jewelry box. The larger jewelry box has a volume of  $80 \text{ in}^3$ . The difference in volume between the jewelry boxes is  $20 \text{ in}^3$ . What could be the dimensions of Lila's smaller jewelry box?

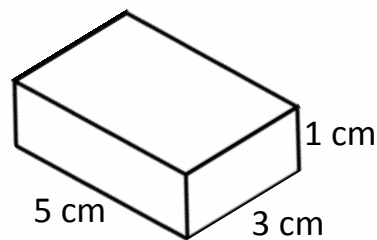
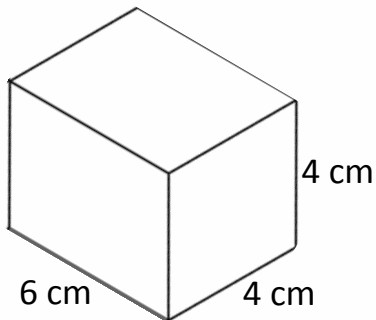
**Answers will vary, but product must be 60.**  
**Example-  $4 \times 5 \times 3$  or  $6 \times 2 \times 5$**

# INDEPENDENT PRACTICE

1. John's playroom has two toy bins. One has a volume of  $80 \text{ ft}^3$  and the other has a volume of  $55 \text{ ft}^3$ . Find the difference in volume between these two toy bins.

$$25 \text{ ft}^3$$

2. What is the combined volume of the two boxes shown below?

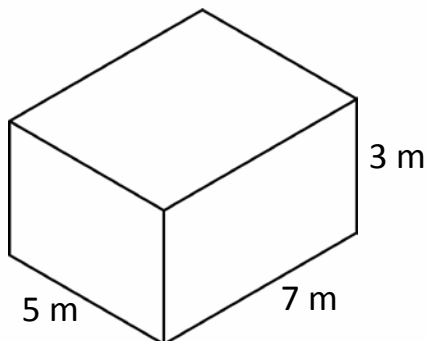


$$96 + 15 = 111 \text{ cm}^3$$

3. Felicity needs a storage container for her block set. The blocks are cubes with a side length of 2 cm. Felicity has 30 blocks. What does the volume of the container need to be?

$$2 \times 2 \times 2 = 8$$
$$8 \times 30 = 240 \text{ cm}^3$$

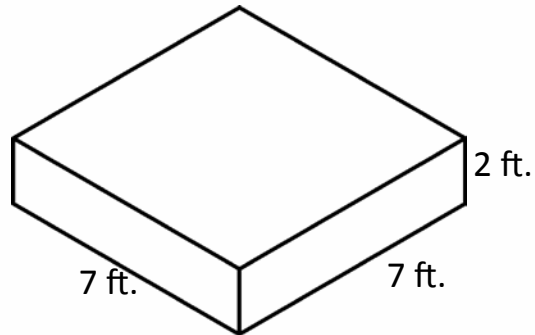
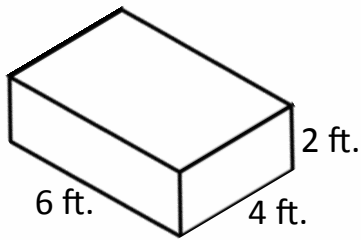
4. An aquarium has two dolphin tanks with a combined volume of  $850 \text{ yds}^3$ . The smaller of the two dolphin tanks is shown below. What is the volume of the larger dolphin tank?



$$5 \times 7 \times 3 = 105$$
$$850 - 105 = 745 \text{ yd}^3$$

# INDEPENDENT PRACTICE

5. Stella owns a quilting business. She builds two storage containers to hold her quilts. What is the combined volume of the two containers?

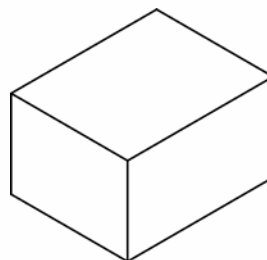
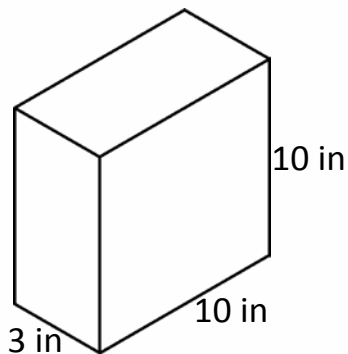


$$48 + 98 = 146 \text{ ft}^3$$

6. The trunk of Louise's car has volume of 13 cubic feet. Jack's car has three times as much trunk space as Louise's car. What is volume of the trunk of Jack's car?

$$39 \text{ ft}^3$$

7. The two boxes below have a combined volume of  $500 \text{ in}^3$ . What could be the dimensions of the second box?



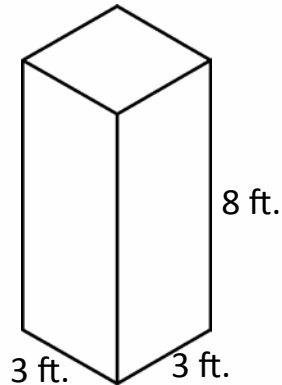
*Answers will vary, but product must be 200.  
Examples-  $10 \times 2 \times 10$   
or  $5 \times 5 \times 8$*

8. A stack of boxes in Mitchell's cupboard have a combined volume of  $1,200 \text{ ft}^3$ . If all 24 boxes have an equal volume, what is the volume of each box?

$$50 \text{ ft}^3$$

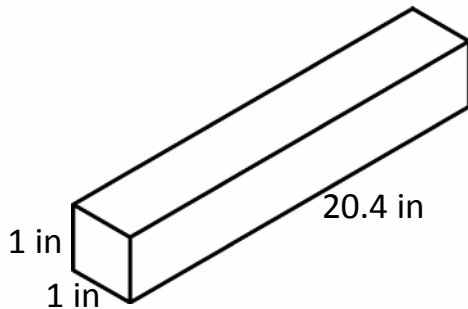
# INDEPENDENT PRACTICE

9. Dora built a tool shed with a volume that is  $48 \text{ ft}^2$  greater than the toolshed shown below. If the height of Dora's toolshed is the same as the one below, what could the length and width be?



**Answers will vary, but the product must be 15.  
 $5 \times 3$  or  $15 \times 1$**

10. Jessica cut the board below into 12 equal pieces. What is the volume of each piece?

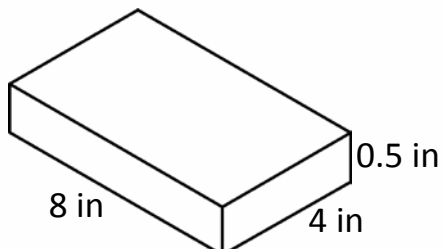


**$1.7 \text{ in}^3$**

11. Joseph paid for  $200 \text{ ft}^3$  of storage space on the cargo hold of a ship. He would like to have two storage containers with equal volume but different dimensions. What could the dimensions be of each storage container?

**Answers will vary, but the product must be 100.  
Example-  $10 \times 10 \times 1$  or  $5 \times 4 \times 5$**

12. Max built a tool box with the same height as the one shown below. The length and width are each two inches longer. How much greater is the volume of Max's toolbox than the one shown below?



$$\begin{aligned} 8 \times 4 \times 0.5 &= 16 \text{ in}^3 \\ 10 \times 6 \times 0.5 &= 30 \text{ in}^3 \\ 30 - 16 &= 14 \text{ in}^3 \end{aligned}$$

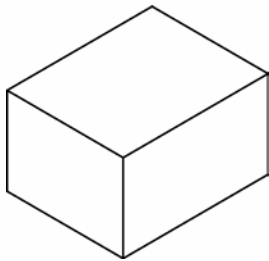
# CHALLENGE

1. Container A and Container B have a combined volume of  $600 \text{ cm}^3$ . Container A is twice as big as Container B. What is the volume of each container?

$$A = 400 \text{ cm}^3$$

$$B = 200 \text{ cm}^3$$

2. The rectangular prism below has a volume of  $64 \text{ ft}^3$ . The length is double the width. The height is half the width. What are the three dimensions?



$$h = 2 \text{ feet}$$

$$w = 4 \text{ feet}$$

$$l = 8 \text{ feet}$$

3. Complete the statement below.

*When I double the dimensions of a rectangular prism, the volume is 8 times bigger.*

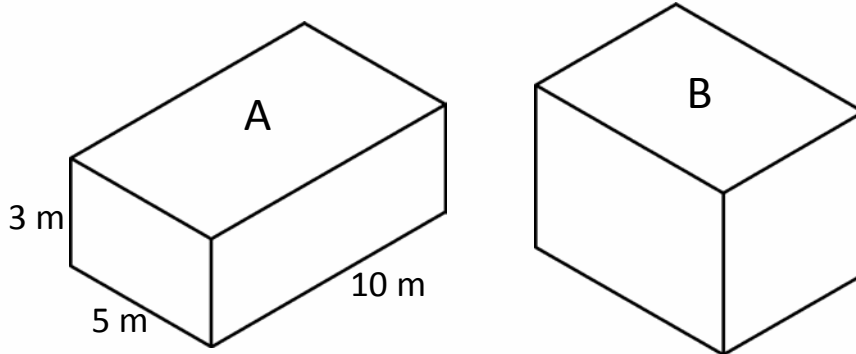
4. Complete the statement below.

*When I triple the dimensions of a rectangular prism, the volume is 27 times bigger.*

# EXIT QUIZ: PROBLEM SOLVING WITH VOLUME

## ANSWER KEY

1. The combined volume of Box A and Box B is  $240 \text{ m}^3$ . What is the volume of box B?



$$5 \times 3 \times 10 = 150$$
$$240 - 150 = 90 \text{ m}^3$$

2. Jonathon built a wall out of concrete bricks. Each brick is a cube with a side length of 3 feet. If Jonathon used 20 bricks to build the wall, what is its volume?

$$3 \times 3 \times 3 = 27$$
$$27 \times 20 = 540 \text{ ft}^3$$

## BONUS

Janice has two boxes she uses to store family photographs. Both boxes have a height of 4 inches, but one box has twice the volume of the other. What could the length and width of each box be?

**Answers will vary. Possible answers:**  
**Box 1-  $2 \times 2$ , Box 2-  $2 \times 4$**   
**Box 1-  $5 \times 2$ , Box 2-  $5 \times 4$**