Chapter 9

Volume and Surface Area

Philipp Nemenz/The Image Bank/Getty Images

Essential Question

HOW is shape important when measuring a figure?

Common Core GPS

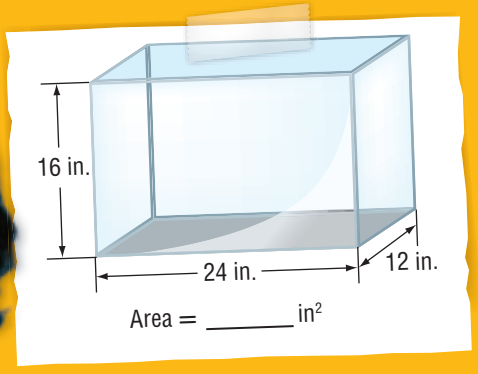
Content Standards
MCC6.G.2, MCC6.G.4

Mathematical Practices
1, 2, 3, 4, 5, 6, 7, 8

Math in the Real World

Aquariums Two-dimensional figures have area, while three-dimensional figures have volume and surface area.

A 20-gallon aquarium can measure 24 inches wide, 12 inches deep, and 16 inches high. What is the area of the bottom of the aquarium?



FOLDABLES® Study Organizer

1. Cut out the correct Foldable from the FL pages in the back of this book.
2. Place your Foldable on the Key Concept page toward the end of this chapter.
3. Use the Foldable throughout this chapter to help you learn about volume and surface area.

What Tools Do You Need?

Vocabulary

base	slant height
cubic units	surface area
lateral face	three-dimensional figure
prism	triangular prism
pyramid	vertex
rectangular prism	volume

Review Vocabulary

Using a graphic organizer can help you to remember important vocabulary terms. Fill in the graphic organizer below for the phrase *two-dimensional figure*.

two-dimensional figure

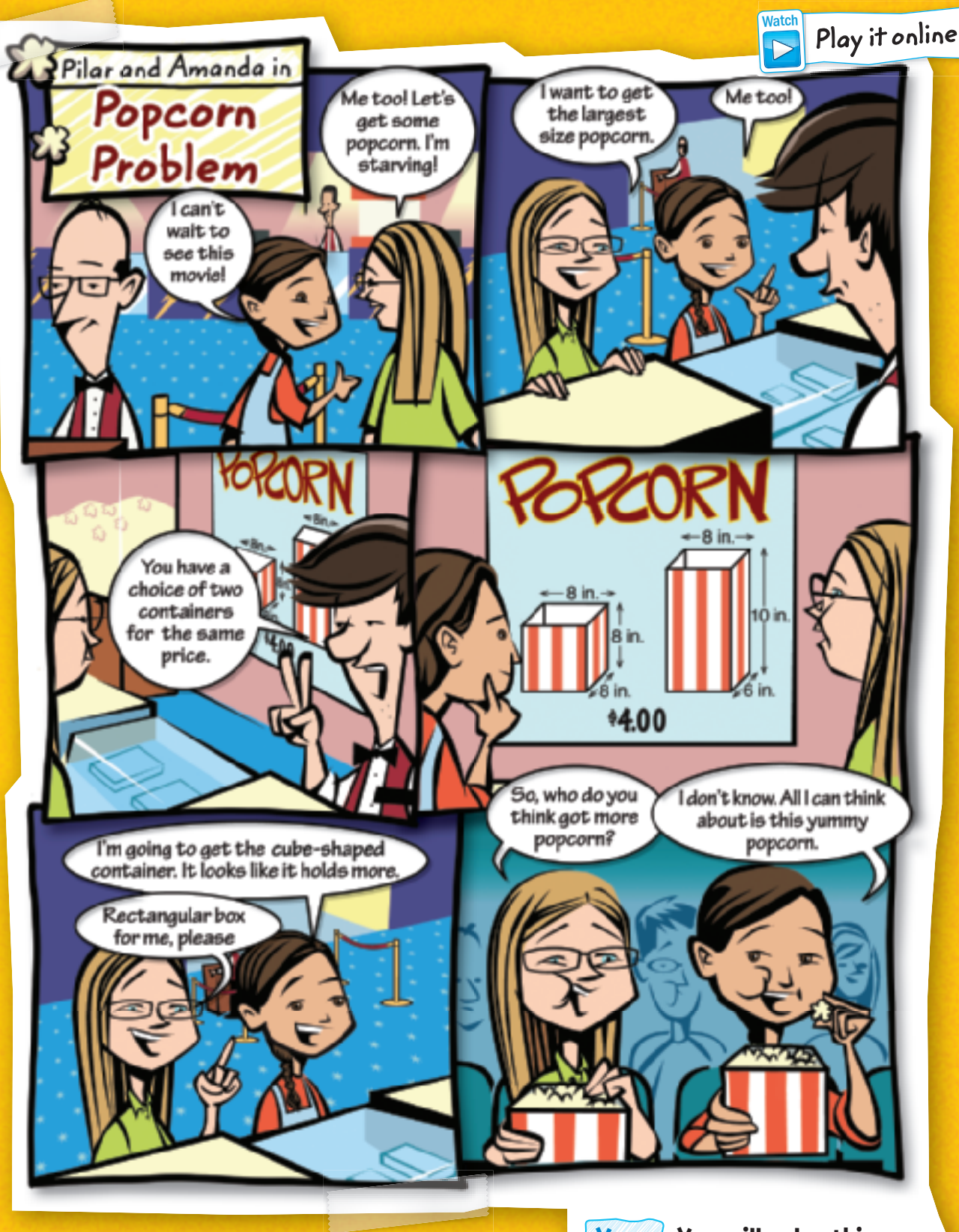
Definition

Real-World Examples

Drawings

The number of square units needed to cover the surface of a closed figure is the _____.

When Will You Use This?



Watch Play it online!

Your Turn! You will solve this problem in the chapter.

Are You Ready?

Try the Quick Check below.
Or, take the Online Readiness Quiz.

Quick Review

Common Core Review MCC5.OA.1, MCC5.NBT.5, MCC5.NBT.7

Example 1

Find $16 \times 2.5 \times 8$.

$16 \times 2.5 = 40$ Multiply 16 and 2.5.
$40 \times 8 = 320$ Multiply the product by 8.

Example 2

Evaluate $(6 \times 4) + (3 \times 5)$.

$(6 \times 4) + (3 \times 5) = 24 + 15$ Multiply.
$= 39$ Add.

Quick Check

Decimals **Multiply.**

1. $3 \times 5.5 \times 13 =$ _____

2. $9.8 \times 4 \times 15 =$ _____

3. $18 \times 1.6 \times 6 =$ _____

Show your work.

4. Dante earned $7.25 for each hour he worked. If he worked 8 hours a week for 4 weeks, how much did he earn?

_____

Numerical Expressions **Evaluate each expression.**

5. $(3 \times 12) + (4 \times 2) =$ _____

6. $(9 \times 7) + (6 \times 4) =$ _____

7. $(15 \times 3) + (8 \times 7) =$ _____

How Did You Do?

Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.

1 2 3 4 5 6 7

Inquiry Lab
Volume of Rectangular Prints

Content Standards
MCC6.G.2
Mathematical Practices
1, 3, 4

HOW can you use models to find volume?

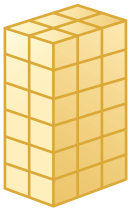
Storage Desmond is purchasing a storage cabinet. The cabinet is 2 feet wide, 3 feet long, and 6 feet tall. What is the volume of the cabinet?

Investigation 1

Watch Tools

You can use centimeter cubes to find the *volume* of the cabinet. Volume is the amount of space inside a three-dimensional figure. Volume is measured in *cubic units*. Each cube of your model represents 1 cubic foot.

Step 1 Build a model that is 2 cubes wide, 3 cubes long, and 6 cubes tall.



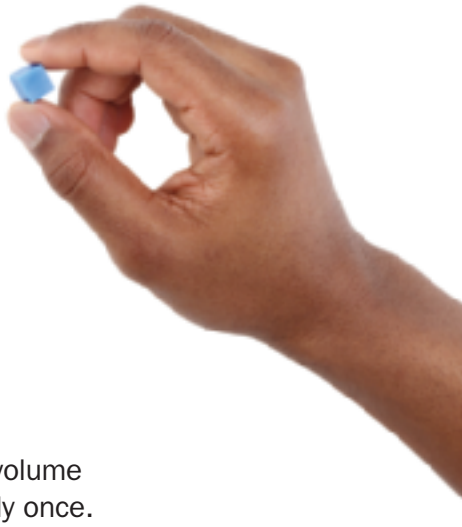
Step 2 Count the number of cubes used to build the model. The model uses ☐ cubes.

So, the volume of the cabinet is ☐ cubic feet.

Find the product of the dimensions of the cabinet.

☐ × ☐ × ☐ = ☐

The product is _____ as the volume.



Collaborate

Work with a partner. Use 36 cubes. Build all the possible prisms with a volume of 36 cubic units. List the dimensions below. Use each set of factors only once.

☐ × ☐ × ☐ = 36
☐ × ☐ × ☐ = 36
☐ × ☐ × ☐ = 36
☐ × ☐ × ☐ = 36

☐ × ☐ × ☐ = 36
☐ × ☐ × ☐ = 36
☐ × ☐ × ☐ = 36
☐ × ☐ × ☐ = 36

Investigation 2

You can find the volume of rectangular prisms with fractional side lengths.

Step 1 The model to the right is _____ cubes long, _____ cube wide, and _____ cube tall.

Step 2 Count the number of cubes used to build the model.

The model uses _____ cubes.

So, the volume of the model is _____ cubic feet.

Compare the product of the dimensions of the prism with its volume.

_____ × _____ × _____ = _____

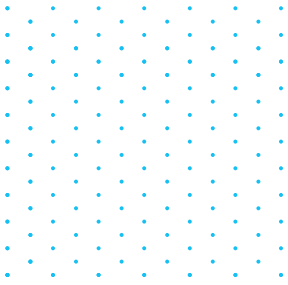
They are _____.

Investigation 3

You can use cubes of candy to find the volume of rectangular prisms with fractional sides.

Step 1 Cut one piece of candy into two halves.

Step 2 Make a model that is $2\frac{1}{2}$ cubes long, 2 cubes wide, and 1 cube tall. Draw a picture of your model.



Step 3 Count the number of cubes used to build the model. The model uses _____ whole cubes and _____ half-cubes.

Two halves equal one whole. So, a total of _____ cubes were used.

So, the volume of the prism is _____ cubic units.

Compare the product of the dimensions of the prism with its volume.

_____ × _____ × _____ = _____

They are _____.

Collaborate

Model with Mathematics **Work with a partner. Use models to determine the volume of each prism. Draw a diagram of each model in the space provided.**

1. length: 1
height: 1
width: 1
volume: _____

Show your work.

2. length: 2
height: 4
width: 1
volume: _____

3. length: 3
height: 4
width: 2
volume: _____

4. length: $\frac{1}{2}$
height: 1
width: 1
volume: _____

5. length: $2\frac{1}{2}$
height: 4
width: 1
volume: _____

6. length: $3\frac{1}{2}$
height: 2
width: 2
volume: _____

Analyze

Work with a partner to complete the table. Use models, if needed. The first one is done for you.

	Prism	Height	Length	Width	Volume
	A	6	3	2	36
7.	B	$2\frac{1}{2}$	$1\frac{1}{2}$	2	
8.	C	5	$1\frac{1}{2}$	2	
9.	D	2	5	$1\frac{1}{2}$	
10.	E	5	3	4	

11. Compare the dimensions for prism *C* to the dimensions of prism *D*. Compare the volume of the two prisms. What do you notice?

12. The length and width of prisms *B* and *C* are equal. Compare the height of the two prisms. How does the change in height affect the change in volume?

13. Compare the dimensions for prism *B* to the dimensions of prism *E*. Compare the volume of the two prisms. What do you notice?

14. **Reason Inductively** Describe the relationship between the number of cubes needed and the dimensions of the prism.

Reflect

15. **Model with Mathematics** Write a real-world problem that involves volume of rectangular prisms. Include the dimensions and the volume of the rectangular prism in your response.

16. HOW can you use models to find volume?

Volume of Rectangular Prisms

What You'll Learn

Scan the lesson. Predict two things you will learn about finding the volume of rectangular prisms.

- _____
- _____

Essential Question

HOW is shape important when measuring a figure?

Vocabulary

three-dimensional figure
prism
rectangular prism
volume
cubic units

Common Core GPS

Content Standards
MCC6.G.2

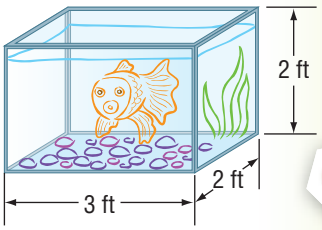
Mathematical Practices
1, 3, 4, 5, 6, 7

Vocabulary Start-Up

Define Volume	When would you use volume?
volume	
Example	Nonexample

Real-World Link

Aquarium The dimensions of an aquarium are shown.



1. What is the area of the base of the aquarium? _____

2. What is the height of the aquarium? _____

3. Fill in the blanks to find the volume.

_____ (length) × _____ (width) × _____ (height) = 12 ft^3

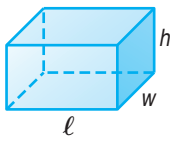
Key Concept

Volume of a Rectangular Prism

Words The volume V of a rectangular prism is the product of its length ℓ, width w, and height h.

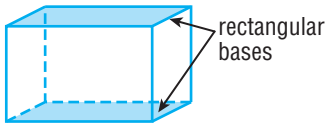
Symbols $V = \ell wh$ or $V = Bh$

Model

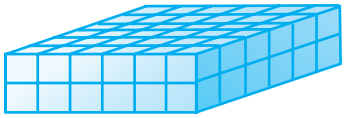


Work Zone

A **three-dimensional figure** has length, width, and height. A **prism** is a three-dimensional figure with two parallel bases that are congruent polygons. In a **rectangular prism**, the bases are congruent rectangles.



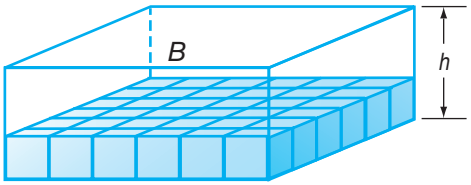
Volume is the amount of space inside a three-dimensional figure. It is measured in **cubic units**, which can be written using abbreviations and an exponent of 3, such as units^3 or in^3.



Cubes
Cubes are special rectangular prisms. All three side lengths are equal. So, the volume of a cube can be written using the formula $V = s^3$.

Decomposing the prism tells you the number of cubes of a given size it will take to fill the prism. The volume of a rectangular prism is related to its dimensions, length, width, and height.

Another method to decompose a rectangular prism is to find the area of the base (B) and multiply it by the height (h).



$V = Bh$

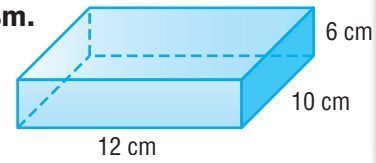
number of rows of cubes needed to fill the prism

area of the base, or the number of cubes needed to cover the base

Example

Tutor

1. **Find the volume of the rectangular prism.**



B, or the area of the base, is 10×12 or 120 square centimeters. The height of the prism is 6 centimeters.

$V = Bh$ Volume of rectangular prism

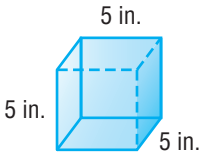
$V = 120 \times 6$ Replace B with 120 and h with 6.

$V = 720$ Multiply.

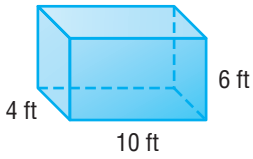
The volume is 720 cubic centimeters.

Got It? **Do these problems to find out.**

a.



b.



Show your work.

a. _____

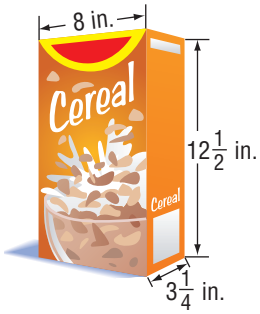
b. _____

Example

Real World

Tutor

2. **A cereal box has the dimensions shown. What is the volume of the cereal box?**



Estimate $10 \times 3 \times 10 = 300$

$V = \ell wh$ Volume of a rectangular prism.

$V = 8 \times 3\frac{1}{4} \times 12\frac{1}{2}$ Replace ℓ with 8, w with $3\frac{1}{4}$, and h with $12\frac{1}{2}$.

$V = \frac{\cancel{8}^{1}}{1} \times \frac{13}{\cancel{4}_{1}} \times \frac{25}{\cancel{2}_{1}}$ Write as improper fractions. Then divide out common factors.

$V = \frac{325}{1}$ or 325 Multiply.

The volume of the cereal box is 325 cubic inches.

Check for Reasonableness $325 \approx 300$ ✓

Got It? **Do this problem to find out.**

c. Find the volume of a container measures 4 inches as its length, 5 inches high, and $8\frac{1}{2}$ inches wide.

c. _____

Decomposing Figures

You can think of the volume of the prism as consisting of six congruent slices. Each slice contains the area of the base, 120 cm^2, multiplied by a height of 1 cm.

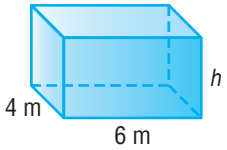
Find Missing Dimensions

To find missing dimensions of a rectangular prism, replace the variables with known measurements. Then solve for the unknown measurement.

Example

Tutor

3. **Find the missing dimension of the prism.**



$V = 84 \text{ m}^3$

$V = \ell wh$	Volume of rectangular prism
$84 = 6 \times 4 \times h$	Replace V with 84, ℓ with 6, and w with 4.
$84 = 24h$	Multiply.
$\frac{84}{24} = \frac{24h}{24}$	Divide each side by 24.
$3.5 = h$	Simplify.

Show your work.

The height of the prism is 3.5 meters.

Check $6 \times 4 \times 3.5 = 84$ ✓

Got It? **Do these problems to find out.**

d. _____

d. $V = 94.5 \text{ km}^3$, $\ell = 7$ km, $h = 3$ km, $w = ?$

Guided Practice

Check

1. A rectangular kitchen sink is 25.25 inches long, 19.75 inches wide, and 10 inches deep. Find the amount of water that can be contained in the sink. (Examples 1 and 2) _____

Show your work.

2. Find the missing dimension of a rectangular prism with a volume of 126 cubic centimeters, a width of $7\frac{7}{8}$ centimeters, and a height of 2 centimeters. (Example 3) _____

3. **Building on the Essential Question** Why can you use either the formula $V = \ell wh$ or $V = Bh$ to find the volume of a rectangular prism?

_____

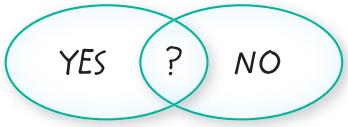
_____

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.



For more help, go online to access a Personal Tutor.

Tutor

FOLDABLES Time to update your Foldable!

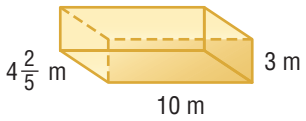
Name _____ My Homework _____

Independent Practice

Go online for Step-by-Step Solutions eHelp

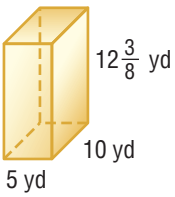
Find the volume of each prism. (Example 1)

1. _____

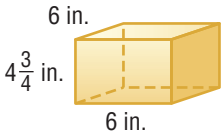


Show your work.

2. _____



3 _____



4. A fishing tackle box is 13 inches long, 6 inches wide, and $2\frac{1}{2}$ inches high. What is the volume of the tackle box? (Example 2)

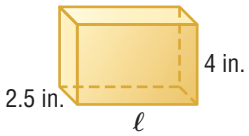
_____

5. Find the length of a rectangular prism having a volume of 2,830.5 cubic meters, width of 18.5 meters, and height of 9 meters. (Example 3)

_____

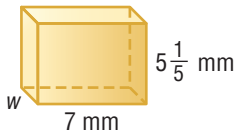
Find the missing dimension of each prism. (Example 3)

6. _____



$V = 60$ in^3

7. _____

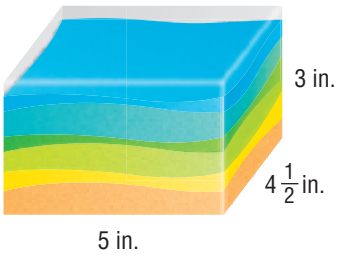


$V = 109\frac{1}{5}$ mm^3

8. **Be Precise** In Japan, farmers have created watermelons in the shape of rectangular prisms. Find the volume of a prism-shaped watermelon in cubic inches if its length is 10 inches, its width is $\frac{2}{3}$ foot, and its height is 9 inches.

_____

9 The glass container shown is filled to a height of 2.25 inches.



a. How much sand is currently in the container?

_____

b. How much more sand could the container hold before it overflows? _____

c. What percent of the container is filled with sand? _____

10. **Identify Structure** Refer to the graphic novel frame below for Exercises a–c.

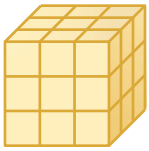
a. What is the volume of the short box Pilar chose on the left?

b. What is the volume of Amanda's tall popcorn box on the right?

c. Who received more popcorn, Pilar or Amanda? How much more?

H.O.T. Problems Higher Order Thinking

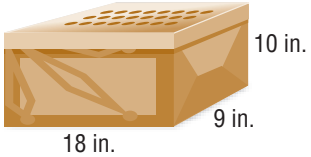
11. **Persevere with Problems** Refer to the prism at the right. If all the dimensions of the prism doubled, would the volume double? Explain your reasoning.



12. **Justify Conclusions** Which has the greater volume: a prism with a length of 5 inches, a width of 4 inches, and a height of 10 inches, or a prism with a length of 10 inches, a width of 5 inches, and a height of 4 inches? Justify your selection.

Georgia Test Practice

13. Don used the shoebox to create a home for the toad he caught. Find the volume of the shoebox.



Ⓐ 222 in^3

Ⓑ 864 in^3

Ⓒ 1,620 in^3

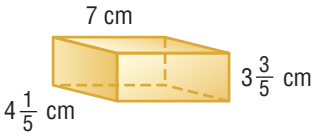
Ⓓ 1,710 in^3

Name _____ My Homework _____

Extra Practice

Find the volume of each prism.

14. $105.84\ cm^3$



$V = \ell wh$

$V = 7 \times 4\frac{1}{5} \times 3\frac{3}{5}$

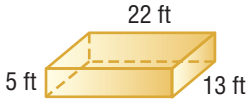
$V = \frac{7}{1} \times \frac{21}{5} \times \frac{18}{5}$

$V = \frac{2{,}646}{25}$

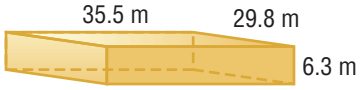
$V = 105.84$

Homework Help

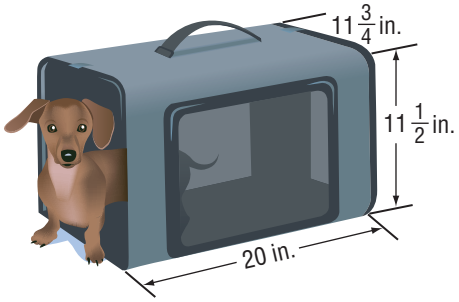
15. _____



16. _____



17. Find the volume of the pet carrier shown at the right.



18. What is the width of a rectangular prism with a length of 13 feet, volume of 11,232 cubic feet, and height of 36 feet?

19. The Palo Duro Canyon is 120 miles long, as much as 20 miles wide, and has a maximum depth of more than 0.15 mile. What is the approximate volume of this canyon?

20. CCSPS **Use Math Tools** Use the table at the right.

a. What is the approximate volume of the small truck?

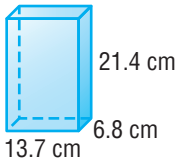
b. The Davis family is moving, and they estimate that they will need a truck with about 1,250 cubic feet. Which truck would be best for them to rent?

c. About how many cubic feet greater is the volume of the Mega Moving Truck than the 2-bedroom moving truck?

Inside Dimensions of Moving Trucks			
Truck	**Length (ft)**	**Width (ft)**	**Height (ft)**
Van	10	$6\frac{1}{2}$	6
Small Truck	$11\frac{1}{13}$	$7\frac{5}{12}$	$6\frac{3}{4}$
2-Bedroom Moving Truck	$14\frac{1}{2}$	$7\frac{7}{12}$	$7\frac{1}{6}$
3-Bedroom Moving Truck	$20\frac{5}{6}$	$7\frac{1}{2}$	$8\frac{1}{12}$
Mega Moving Truck	$22\frac{1}{4}$	$7\frac{7}{12}$	$8\frac{5}{12}$

Georgia Test Practice

21. Poppy's Pasta comes in the rectangular box shown. What is the volume of the box?



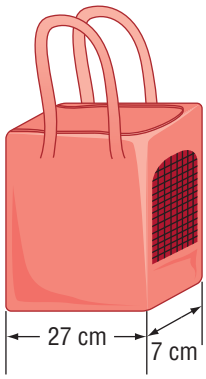
Ⓐ 41.9 cm^3

Ⓑ 93.16 cm^3

Ⓒ 1,993.624 cm^3

Ⓓ 2,058 cm^3

22. A pet carrier company is creating a new size carrier. It has a width of 27 centimeters, a length of 7 centimeters, and a volume of 6,426 cubic centimeters. Find the height.



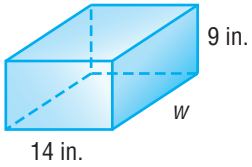
Ⓕ 34 centimeters

Ⓖ 38 centimeters

Ⓗ 42 centimeters

Ⓘ 46 centimeters

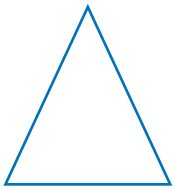
23. Short Response The volume of the rectangular prism shown is 2,520 cubic inches. Find the width of the prism.



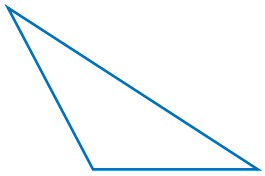
Common Core Review

Classify each triangle by the measure of the angles. MCC5.G.4

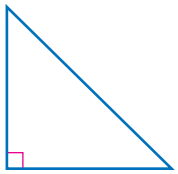
24.



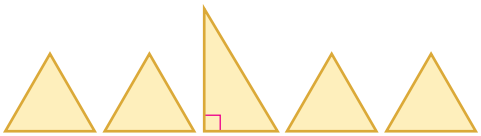
25.



26.



27. Draw the next figure in the pattern below. MCC4.OA.5, MCC4.G.2



28. Triangles are often used in designing bridges. Classify the triangle shown by the measure of its sides. Explain. MCC5.G.4

Lesson 2

Volume of Triangular Prisms

What You'll Learn

Scan the lesson. Predict two things you will learn about finding the volume of triangular prisms.

- _____
- _____

Essential Question

HOW is shape important when measuring a figure?

Vocabulary

triangular prism

Common Core GPS

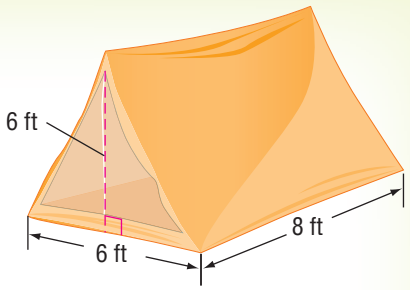
Content Standards
Extension of MCC6.G.2

Mathematical Practices
1, 3, 4, 6, 8

Real-World Link

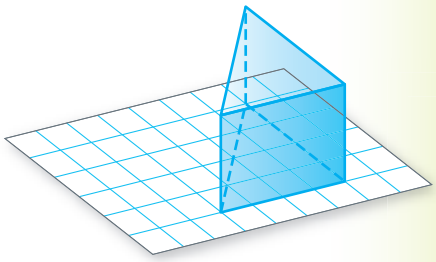
Watch

Camping Ari has a pup tent like the one shown. The opening of the tent has a base and a height of 6 feet. The length of the tent is 8 feet.



What is the area of the front triangular face? _____

Collaborate On a piece of grid paper, draw a right triangle with a base and height of 4 units as shown.



1. What is the area of the triangle?

   _____

2. Suppose you cover the triangle with cubes the size of one square on the grid paper. How many cubes would you use? (*Hint*: You can cut and reassemble the cubes.) _____

3. How many cubes would you use if you had 4 layers? _____

4. **Make a Conjecture** Write a formula to find the volume of a triangular prism. _____

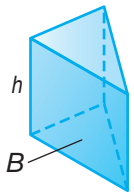
Key Concept

Volume of a Triangular Prism

Words The volume V of a triangular prism is the area of the base B times the height h.

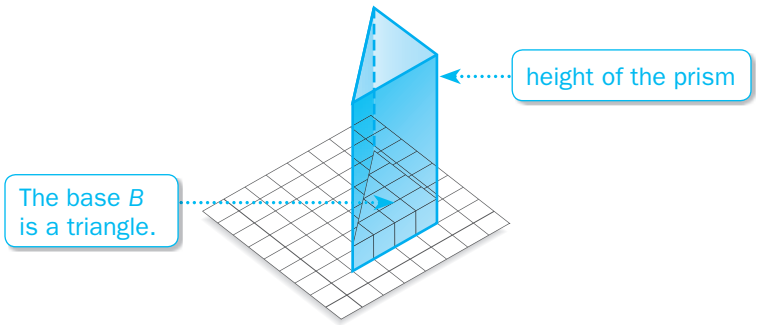
Symbols $V = Bh$, where B is the area of the base

Model



Work Zone

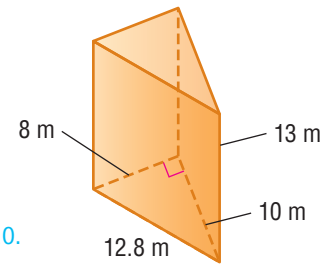
In a **triangular prism**, the bases are congruent triangles. The diagram below shows that the volume of a triangular prism is also the product of the area of the base B and the height h of the prism.



Example

Tutor

1. **Find the volume of the triangular prism.**



The area of the triangle is $\frac{1}{2} \cdot 8 \cdot 10$, so B is $\frac{1}{2} \cdot 8 \cdot 10$.

$V = Bh$ Volume of a prism

$V = \left(\frac{1}{2} \cdot 8 \cdot 10\right)h$ Replace B with $\frac{1}{2} \cdot 8 \cdot 10$.

$V = \left(\frac{1}{2} \cdot 8 \cdot 10\right)13$ Replace h with 13, the height of the prism.

$V = 520$ Multiply.

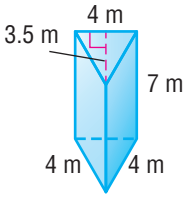
The volume is 520 cubic meters or 520 m^3.

Base
Before finding the volume of a triangular prism, identify the base. In Exercise b, the base is not on the "bottom." The base is one of the parallel faces.

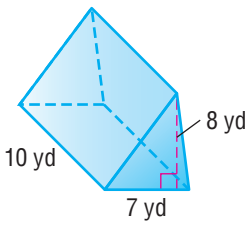
Show your work.

Got It? Do these problems to find out.

a.



b.



a. _____

b. _____

Example

2. **A large skateboard ramp is shown. Find the volume of the triangular prism.**

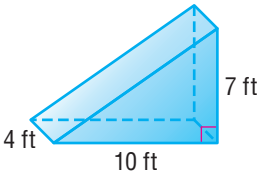
The base is a triangle with a base length of 10 feet and a height of 7 feet. The height of the prism is 4 feet.

$V = Bh$ Volume of a prism

$V = \left(\frac{1}{2} \cdot 10 \cdot 7\right)h$ Replace B with $\frac{1}{2} \cdot 10 \cdot 7$.

$V = \left(\frac{1}{2} \cdot 10 \cdot 7\right)4$ Replace h with 4, the height of the prism.

$V = 140$ Multiply.



The volume is 140 cubic feet or 140 ft^3.

Got It? **Do this problem to find out.**

Show your work.

c. Find the volume of a triangular prism-shaped model with a base of 32 square centimeters and a height of 6 centimeters.

c. _____

Find Missing Dimensions

To find missing dimensions of a triangular prism, replace the variables with known measurements. Then solve for the unknown measurement.

Example

3. **Find the height of the triangular prism.**

$V = Bh$ Volume of a triangular prism

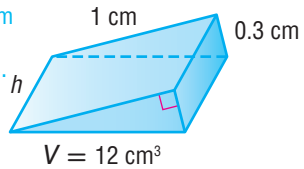
$V = \left(\frac{1}{2} \cdot 1 \cdot 0.3\right)h$ Replace B with $\frac{1}{2} \cdot 1 \cdot 0.3$.

$12 = \left(\frac{1}{2} \cdot 1 \cdot 0.3\right)h$ Replace V with 12.

$12 = 0.15h$ Multiply.

$\frac{12}{0.15} = \frac{0.15h}{0.15}$ Divide each side by 0.15.

$80 = h$ Simplify.



So, the height of the prism is 80 cm.

Got It? **Do these problems to find out.**

Find the missing dimension of the triangular prism.

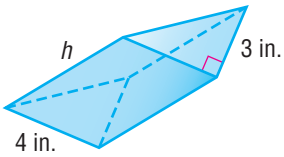
d. $V = 55$ km^3, base length = 2 km, base height = 5 km, h = ?

d. _____

Example

Tutor

4. **Dwane bought a cheese wedge for his March Madness party. The cheese wedge has the dimensions shown. The volume of the cheese wedge is 54 cubic inches. What is the height of the cheese wedge?**



$V = Bh$	Volume of a triangular prism
$54 = \left(\frac{1}{2} \cdot 3 \cdot 4\right)h$	Replace V with 54, and B with $\frac{1}{2} \cdot 3 \cdot 4$.
$54 = 6h$	Multiply.
$\frac{54}{6} = \frac{6h}{6}$	Divide each side by 6.
$9 = h$	Simplify.

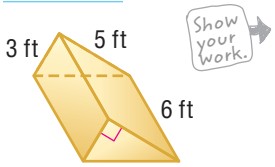
So, the height of the cheese wedge is 9 inches.

Guided Practice

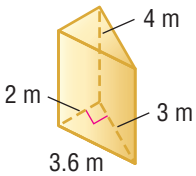
Check

Find the volume of each prism. Round to the nearest tenth if necessary. (Example 1)

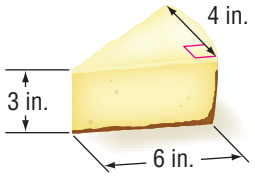
1.



2.



3. Dirk has a triangular-shaped piece of cheesecake in his lunch. Find the volume of the piece of cheesecake. (Example 2)



4. Find the base length of a shipping box in the shape of a triangular prism. The shipping box has a volume of 276 cubic feet, a base height of 6.9 feet, and a height of 10 feet. (Examples 3 and 4)

5. **Building on the Essential Question** How is the area of a triangle related to the volume of a triangular prism?

Rate Yourself!

How well do you understand volume of triangular prisms? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

For more help, go online to access a Personal Tutor.

Tutor

FOLDABLES Time to update your Foldable!

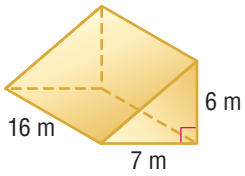
Name _____ My Homework _____

Independent Practice

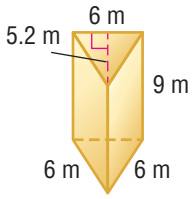
Go online for Step-by-Step Solutions eHelp

Find the volume of each prism. Round to the nearest tenth if necessary. (Example 1)

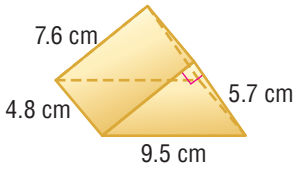
1. _____



2. _____



3 _____



4. A wheelchair ramp is in the shape of a triangular prism. It has a base area of 37.4 square yards and a height of 5 yards. Find the volume of the ramp. (Example 2)

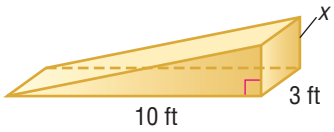
_____

5 A triangular prism has a height of 9 inches. The triangular base has a base of 3 inches and a height of 8 inches. Find the volume of the prism. (Example 2)

_____

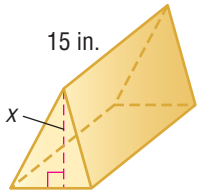
Find the missing dimension of each triangular prism. (Example 3)

6. $x =$ _____



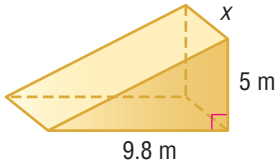
$V = 30 \text{ ft}^3$

7. $x =$ _____



$V = 390 \text{ in}^3$

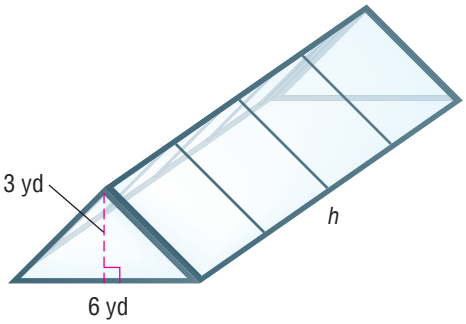
8. $x =$ _____



$V = 98 \text{ m}^3$

9. Mr. Standford's greenhouse has the dimensions shown. The volume of the greenhouse is 90 cubic yards. Find the missing dimension of the greenhouse. (Example 4)

_____



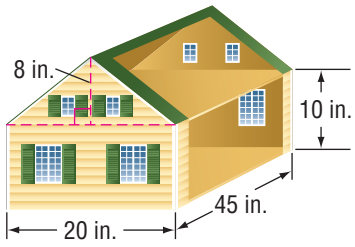
10. **Be Precise** Darcy built the dollhouse shown.

a. What is the volume of the first floor?

_____

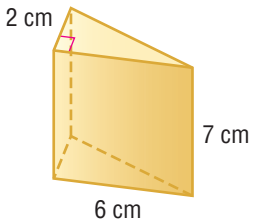
b. What is the volume of the attic space?

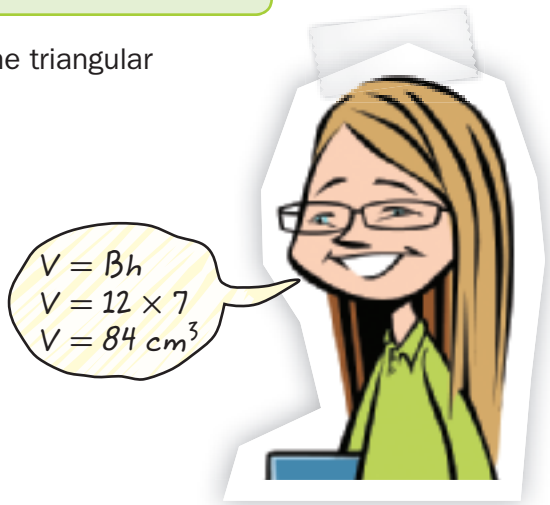
_____



H.O.T. Problems Higher Order Thinking

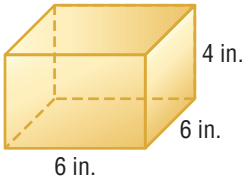
11. **Find the Error** Amanda is finding the volume of the triangular prism. Find her mistake and correct it.

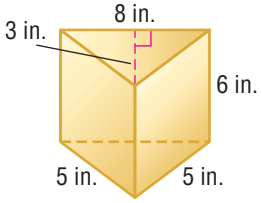




12. **Identify Repeated Reasoning** A rectangular prism and a triangular prism each have a volume of 210 cubic meters. Find possible sets of dimensions for each prism.

13. **Persevere with Problems** A candy company sells mints in two different containers. Which container shown below holds more mints? Justify your answer.

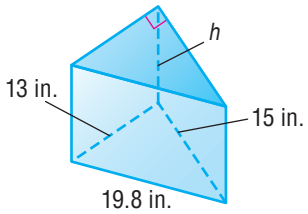




Georgia Test Practice

14. A triangular prism has a volume of 1,560 cubic inches and a base of 13 inches by 15 inches. What is the height of the prism?

Ⓐ 8 in.
Ⓑ 12 in.
Ⓒ 16 in.
Ⓓ 24 in.

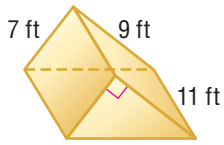


Name _____ My Homework _____

Extra Practice

Find the volume of each prism. Round to the nearest tenth if necessary.

15. $346.5\ ft^3$



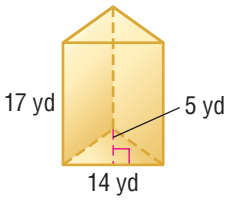
Homework Help

$V = Bh$

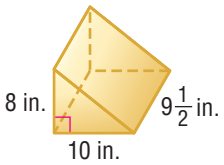
$V = \left(\frac{1}{2} \cdot 7 \cdot 9\right)(11)$

$V = 346.5$

16. _____



17. _____



18. A candle is in the shape of a triangular prism. The base has an area of 30 square inches. The candle has a height of 6 inches. Find the volume of the candle.

_____

_____

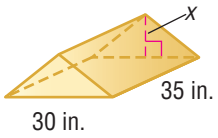
19. A cabinet is in the shape of a triangular prism. The triangular base has a base length of 14 inches and a base height of 22 inches. The cabinet is 67.5 inches tall. What is the volume of the cabinet?

_____

_____

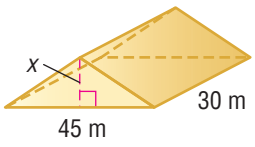
Find the missing dimension of each triangular prism.

20. $x =$ _____



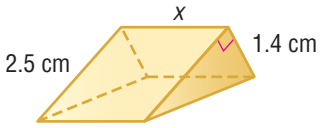
$V = 6{,}300\ in^3$

21. $x =$ _____



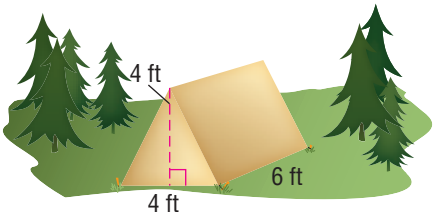
$V = 10{,}125\ m^3$

22. $x =$ _____



$V = 3.5\ cm^3$

23. What is the volume of the A-frame tent shown?



_____

_____

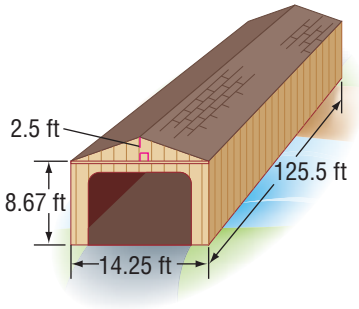
24. CCSS **Be Precise** A covered bridge in Vermont has the dimensions shown.

a. What is the volume of the bottom section rounded to the nearest tenth? _____

_____

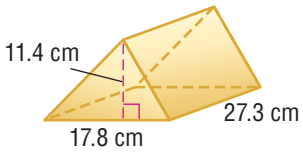
b. What is the volume of the roof, rounded to the nearest tenth? _____

_____



Georgia Test Practice

25. Find the volume of the triangular prism shown, rounded to the nearest tenth.

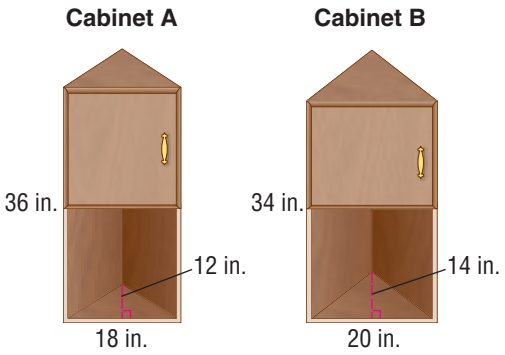


Ⓐ 5,539.7 cm^3
Ⓒ 2,769.9 cm^3
Ⓑ 2,867.3 cm^3
Ⓓ 1,846.6 cm^3

26. A triangular prism has a volume of 240 cubic meters. Which of the measurements below are *not* possible dimensions for the area of the base and the height of the prism?

Ⓕ $B = 48\ m^2$, $h = 5$ m
Ⓖ $B = 24\ m^2$, $h = 10$ m
Ⓗ $B = 12\ m^2$, $h = 20$ m
Ⓘ $B = 20\ m^2$, $h = 4$ m

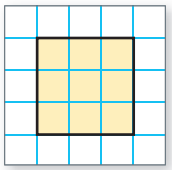
27. Short Response Tia wants to purchase the corner kitchen cabinet with the greater volume. Find the volume of each cabinet to determine which one Tia should buy.



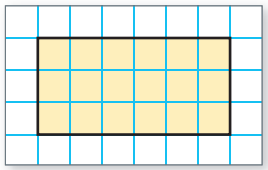
Common Core Review

Find the area of each figure. MCC4.MD.3

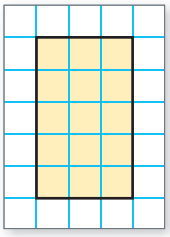
28.



29.



30.



31. Sarah is building a birdhouse. The nails she uses are one inch long. The wood board is 1 foot long. How many times smaller are the nails compared to the wood? MCC4.MD.1 _____

32. The floor area of Melana's rectangular closet is 18 square feet. The closet is 6 feet long. How wide is the closet? MCC4.MD.3 _____

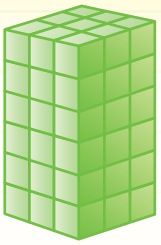
Make a Model

Content Standards
MCC6.G.2, MCC6.G.4
Mathematical Practices
1, 3, 4

Case #1 Scooter Storage

Nick works for a sporting goods store. He is stacking boxes of scooters in the storage space at the back of the store. The first layer has 9 boxes.

If the storage area will hold 6 layers of boxes, how many boxes will the storage space hold?



1 Understand *What are the facts?*

- The first layer has 9 boxes.
- The storage space will hold 6 layers.

2 Plan *What is your strategy to solve this problem?*

Make a model using centimeter cubes.

3 Solve *How can you apply the strategy?*

Make a model of one layer of the box by arranging 9 cubes in a 3 × 3 array.

Continue stacking the cubes until there are 6 layers.

So, the storage space will hold 54 boxes.

4 Check *Does the answer make sense?*

Use the volume formula to check your answer.
$V = 3 \times 3 \times 6$ or 54

So, the storage space will hold a total of 54 boxes.

Analyze the Strategy

Tools Tutor

Justify Conclusions Suppose the boxes are a different size and the first layer has 6 boxes instead. How many boxes can be stored if the storage space will hold 5 layers? Explain.

Case #2 Contain Your Fun

A storage container is made from plastic that measures $1\frac{1}{2}$ feet long, 2 feet wide, and $2\frac{1}{2}$ feet high.

Find the surface area of the plastic container, including the lid.

1 Understand

Read the problem. What are you being asked to find?

I need to find _____.

Underline key words and values in the problem.
What information do you know?

The storage container measures _____ long, _____ wide, and _____ high.

2 Plan

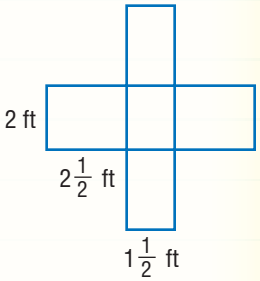
Choose a problem-solving strategy.

I will use the _____ strategy.

3 Solve

Use your problem-solving strategy to solve the problem.

Make a model of the container using a net. Then find the area of each rectangle to find the total surface area.



front and back: 2(_____ × _____) = _____

left and right: 2(_____ × _____) = _____

top and bottom: 2(_____ × _____) = _____

Sum of 6 sides: _____ + _____ + _____ = _____

So, the surface area of the container is _____ square feet.

4 Check

Use information from the problem to check your answer.

Substitute known values into the surface area formula to check your answer.

S.A. = (_____) + (_____) + (_____) = _____ ft^2

Collaborate Work with a small group to solve the following cases. Show your work on a separate piece of paper.

Case #3 Assembly

Watch

DJ is helping set up 7 rows of chairs for a school assembly. There are eight chairs in the first row. Each row after that has two more chairs than the previous row.

If he has 100 chairs, can he set up enough rows? Explain.

Case #4 Paper

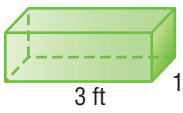
Timothy took a piece of notebook paper and cut it in half. Then he placed the 2 pieces on top of each other and cut them in half again to have 4 pieces of paper.

If he could keep cutting the paper in this manner, how many pieces of paper would he have after 6 cuts?

Case #5 Sports

Rosario is packing a crate with boxes of miniature golf putters. Each box has a height of 1 foot, a width of 1 foot, and a length of 3 feet.

How many boxes can Rosario fit in a crate that is 4 feet high, 4 feet wide, and 3 feet long?

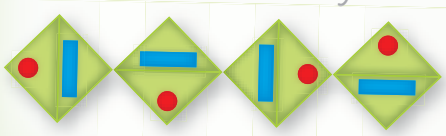


Circle a strategy below to solve the problem.

- Look for a pattern.
- Act it out.
- Work backward.
- Guess, check and revise.

Case #6 Patterns

Draw the seventeenth figure in the pattern.



Show your work.

Mid-Chapter Check

Vocabulary Check

1. **Be Precise** Define *three-dimensional figure*. Give an example of a figure that is a three-dimensional figure and an example of a figure that is not a three-dimensional figure. (Lesson 1)

_____

_____

Fill in the blanks in the sentences below with the correct terms. (Lesson 1)

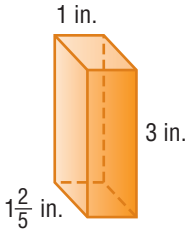
2. Volume is the amount of _____ inside a three-dimensional figure.

3. Volume is measured in _____ units.

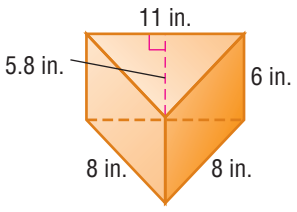
Skills Check and Problem Solving

Find the volume of each prism. Round to the nearest tenth if necessary. (Lessons 1 and 2)

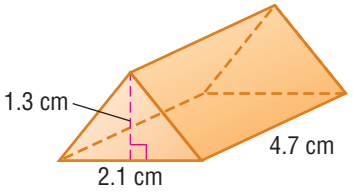
4. _____



5. _____



6. _____



Find the missing dimension of each figure. (Lessons 1 and 2)

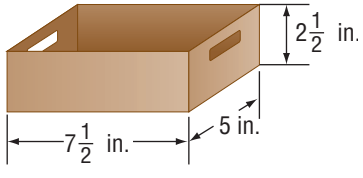
7. rectangular prism: $V = 80$ m^3; length = 5 m; width = 4 m

   h = _____

8. triangular prism: $V = 42$ cm^3; base length = 2 cm; base height = 6 cm

   h = _____

9. A storage unit is in the shape of a rectangular prism. Find the volume of the storage unit. (Lesson 1) _____



10. **Georgia Test Practice** What is the height of a rectangular prism with a volume of 63 cubic feet and a base area of 15 square feet? (Lesson 1)

   Ⓐ 945 feet Ⓒ 48 feet

   Ⓑ 78 feet Ⓓ 4.2 feet

Inquiry Lab
Surface Area of Rectangular Prisms

Inquiry HOW can you use nets to find surface area?

Content Standards
MCC6.G.4
Mathematical Practices
1, 3, 4

Cereal If you want to know the amount of cereal that can fit in the box, you would find the volume. But if you want to know how much cardboard is needed to make the box, you would find the *surface area.*

Investigation 1

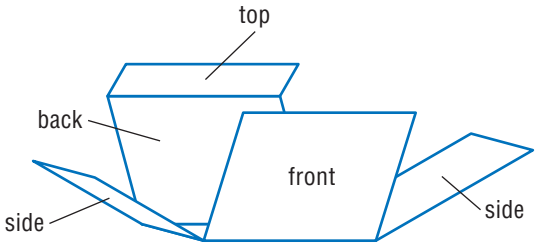
One way to find the surface area is to use a *net.* Nets are two-dimensional patterns of three-dimensional figures. When you construct a net, you are decomposing the three-dimensional figure into separate shapes.

Step 1 Use a cereal box in the shape of a rectangular prism. Measure and record the length, width, and height of the box on the lines below.

Length: _____

Width: _____

Height: _____



Step 2 Using a marker, label the top, bottom, front, back and side faces of the box.

Step 3 Using scissors, carefully cut along three edges of the top face and then cut down each vertical edge.

Step 4 Measure and record the area of each face, using the dimensions of the box shown in the table.

Face	Length	Width	Area of Face
Front			
Back			
Side 1			
Side 2			
Top			
Bottom			

Step 5 Add the areas of each face to find the surface area of the box.

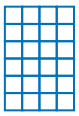
☐ + ☐ + ☐ + ☐ + ☐ + ☐ = ☐

So, the surface area of the box is ☐ square inches.

Investigation 2

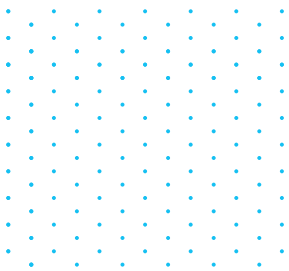
Orthogonal drawings consist of separate views of an object taken from different angles. You can make a net from orthogonal drawings.

Step 1 Find the dimensions of each side of a rectangular prism from the orthogonal drawing.

Orthogonal Drawing		
View	**Drawing**	**Dimensions**
Front and Back		×
Sides		×
Top and Bottom		×

Step 2 Use grid paper to draw a net from the orthogonal drawing. Trace and cut out your drawing and tape it in the space below. Check the dimensions of each face using the information in the table.

Step 3 Fold the net into a three-dimensional figure. Draw the resulting figure in the space provided.



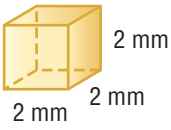
So, the figure is a _____.

It has a surface area of ☐ square units.

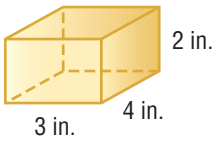
Collaborate

Model with Mathematics **Work with a partner. Use a net to determine the surface area of each prism. Draw a net of each prism on the provided grid.**

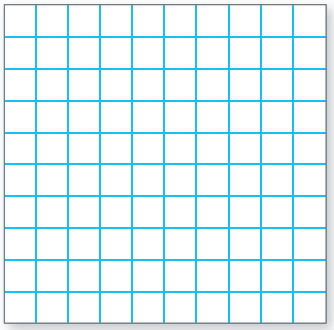
1. _____ mm^2

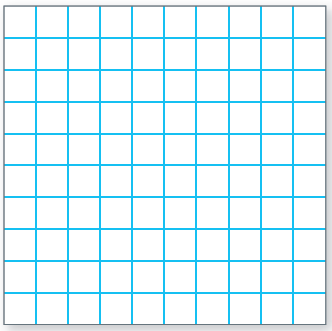


2. _____ in^2

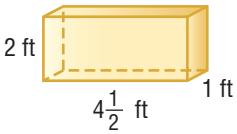


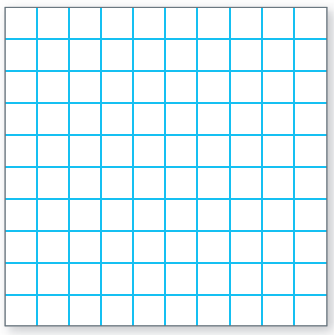
Show your work.



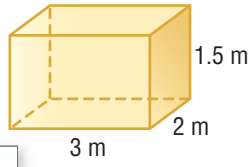


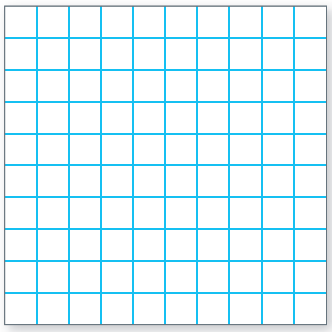
3. _____ ft^2





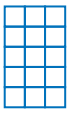
4. _____

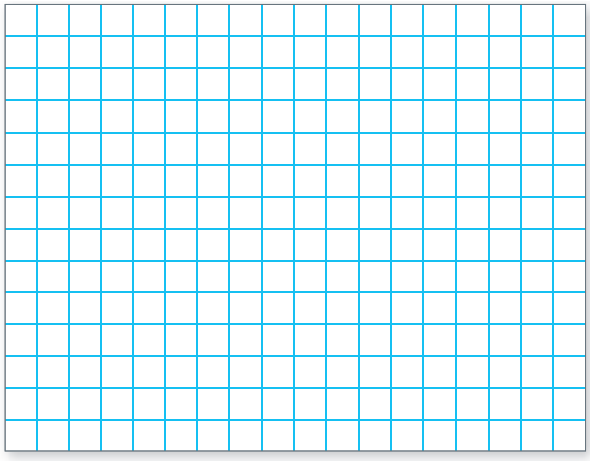




Draw a net on the grid from the orthogonal drawing. Then find the surface area of the prism.

5. _____ square units

Orthogonal Drawing	
View	**Drawing**
Front and Back	
Sides	
Top and Bottom	



Analyze

Work with a partner to complete the table. The first one is done for you.

	Dimensions of Rectangular Prism	Area of Top (units^2)	Area of Bottom (units^2)	Area of Side 1 (units^2)	Area of Side 2 (units^2)	Area of Front (units^2)	Area of Back (units^2)	Surface Area (units^2)
	$1 \times 2 \times 3$	2	2	6	6	3	3	22
6.	$2 \times 2 \times 3$							
7.	$3 \times 3 \times 3$							
8.	$3 \times 2 \times 8$							
9.	$6 \times 6 \times 6$							

10. Compare the surface area for Exercise 7 to the surface area for Exercise 9. How does doubling each dimension affect the surface area?

11. CCSPS **Reason Inductively** Write a formula to find the surface area of a rectangular prism. Use your formula to find the surface area of the prism in Investigation 2.

Reflect

12. CCSPS **Model with Mathematics** Write a real-world problem that involves the surface area of rectangular prisms. Provide the dimensions and the surface area.

13. Will the surface area of a cube ever have the same numerical value as the volume of the cube?

14. inquiry HOW can you use nets to find surface area?

Surface Area of Rectangular Prisms

What You'll Learn

Scan the lesson. Predict two things you will learn about finding the surface area of rectangular prisms.

- _____
- _____

Essential Question

HOW is shape important when measuring a figure?

Vocabulary

surface area

Common Core GPS

Content Standards
MCC6.G.4

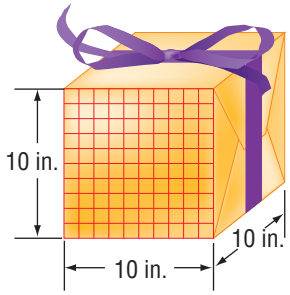
Mathematical Practices
1, 3, 4, 8

Vocabulary Start-Up

Define Surface	Define Area
What is surface area?	Example:

Real-World Link

Gifts Roberta is wrapping a gift for her sister's quinceañera. She places it in a box with the measurements shown below.



1. What is the area of one face of the box?

2. How many faces does the box have? ☐

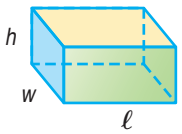
3. What operations would you use to find the surface area of the box?

Work Zone

Key Concept Surface Area of a Rectangular Prism

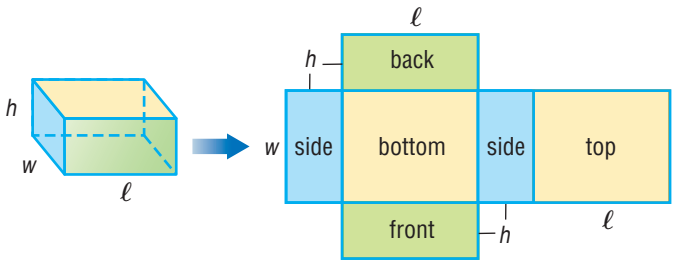
Words The surface area S.A. of a rectangular prism with length ℓ, width w, and height h is the sum of the areas of the faces.

Model



Symbols $S.A. = 2\ell h + 2\ell w + 2hw$

The surface area of a prism is the sum of the areas of its faces.



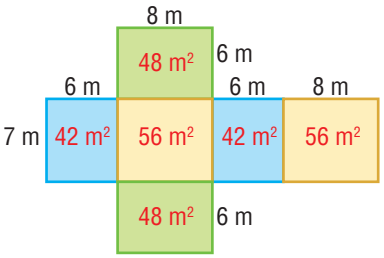
front and back: $\ell h + \ell h = 2\ell h$
top and bottom: $\ell w + \ell w = 2\ell w$
two sides: $hw + hw = 2hw$

$2\ell h + 2\ell w + 2hw$

Example

Watch Tutor

1. **Find the surface area of the rectangular prism.**



Find the area of each pair of faces.

front and back: $2(8 \cdot 6) = 2(48)$

top and bottom: $2(7 \cdot 8) = 2(56)$

sides: $2(7 \cdot 6) = 2(42)$

$48 + 48 + 56 + 56 + 42 + 42 = 292$ Add the area of each face.

So, the surface area is 292 square meters.

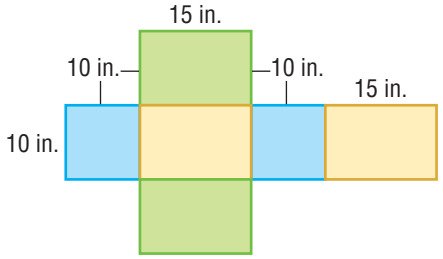
Nets
The net shows that a rectangular prism has six faces. The faces can be grouped as three pairs of congruent sides. The colors indicate which faces are congruent.

Got It? Do this problem to find out.

Show your work.

a. Find the surface area of the rectangular prism.

a. _____



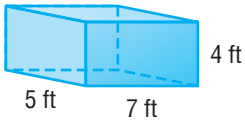
Find Surface Area Using a Formula

You can use nets or models to find the surface area of a rectangular prism. You can also use the surface area formula, $S.A. = 2\ell h + 2\ell w + 2hw$.

Examples

Tutor

2. **Find the surface area of the rectangular prism.**



Find the area of each face.

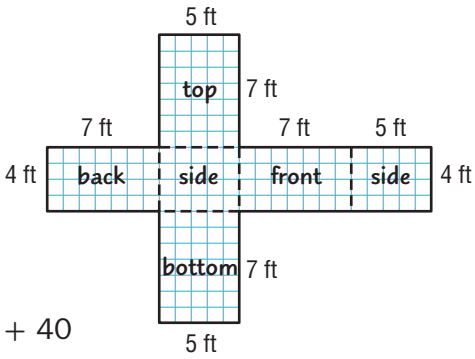
front and back:
$2\ell h = 2(7)(4)$ or 56

top and back:
$2\ell w = 2(7)(5)$ or 70

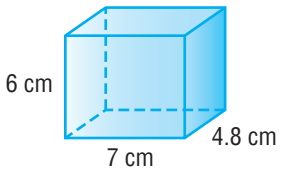
left and right sides:
$2hw = 2(4)(5)$ or 40

Add to find the surface area.

The surface area is 56 + 70 + 40 or 166 square feet.



3. **Find the surface area of the rectangular prism.**



To find the area of each face determine the dimensions.

$\ell = 7, w = 4.8, h = 6$

front and back: $2\ell h = 2(\square)(\square)$ or $\square$

top and bottom: $2\ell w = 2(\square)(\square)$ or $\square$

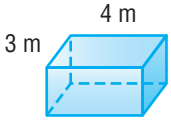
two sides: $2hw = 2(\square)(\square)$ or $\square$

Add to find the surface area.

$\square + \square + \square$ or $\square$ square centimeters

Got It? **Do this problem to find out.**

b. Find the surface area of the rectangular prism.



Show your work.

b. _____

Example

4. STEM **A geode is being sent as a gift. It is packed in a box that measures 7 inches long, 3 inches wide, and 16 inches tall. What is the surface area of the box?**

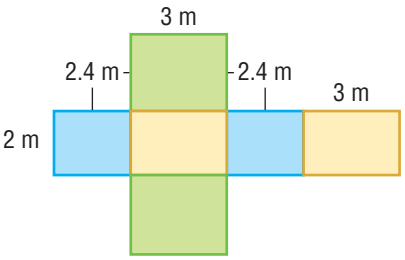
$S.A. = 2\ell h + 2\ell w + 2hw$	Surface area of a prism
$S.A. = 2(7)(16) + 2(7)(3) + 2(16)(3)$	$\ell = 7, w = 3, h = 16$
$S.A. = 14(16) + 14(3) + 32(3)$	Multiply.
$S.A. = 224 + 42 + 96$	Multiply.
$S.A. = 362$	Add.

The surface area of the box is 362 square inches.

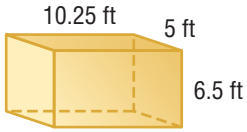
Guided Practice

Find the surface area of each rectangular prism. (Examples 1–3)

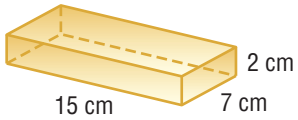
1. _____



2. _____

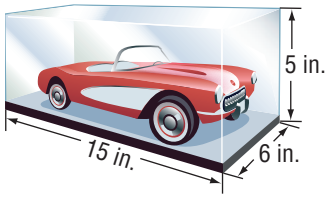


3. _____



Show your work.

4. Tomás keeps his diecast car in a glass display case as shown. What is the surface area of the glass, including the bottom? (Example 4)



_____

5. **Building on the Essential Question** What is the relationship between area and surface area?

_____

_____

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.

For more help, go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

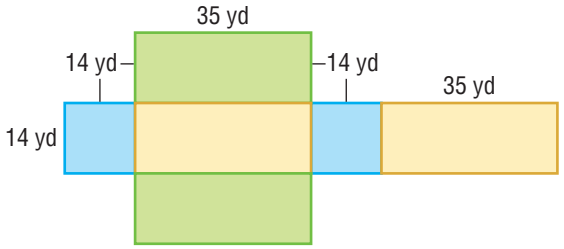
Name _____ My Homework _____

Independent Practice

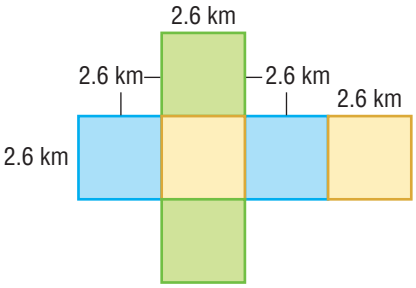
Go online for Step-by-Step Solutions eHelp

Find the surface area of each rectangular prism. (Examples 1–3)

1. _____

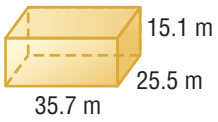


2. _____

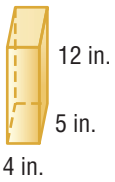


Show your work.

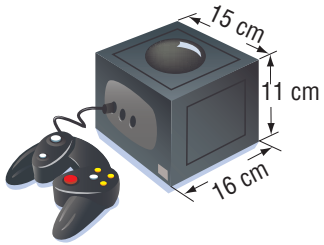
3 _____



4. _____



5. STEM A game box for video games is shaped like a rectangular prism. What is the surface area of the game box? (Example 4)



_____

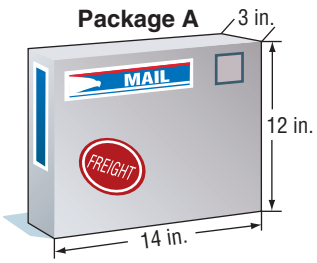
6. CCSPS **Justify Conclusions** Martina estimates that the surface area of a rectangular prism with a length of 13.2 feet, a width of 6 feet, and a height of 8 feet is about 460 square feet. Is her estimate reasonable? Explain your reasoning.

_____

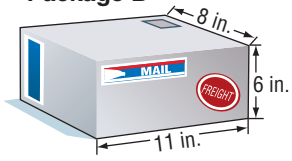
_____

7 CCSPS **Justify Conclusions** Find the surface area of each shipping package. Which package has the greater surface area? Does the same package have a greater volume? Explain your reasoning to a classmate.

Package A



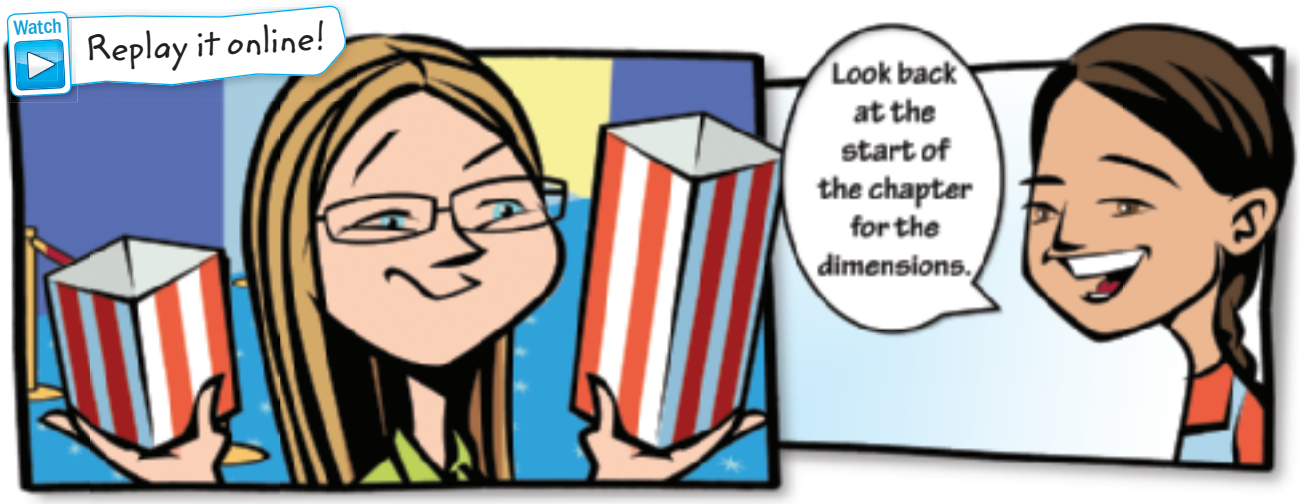
Package B



_____

_____

8. **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–c. (*Hint:* The boxes are missing the top face.)



a. What is the surface area of the short box on the left? _____

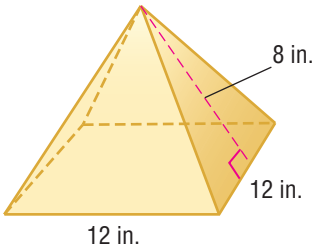
b. What is the surface area of the tall box on the right? _____

c. How much more surface area does the larger container have?

_____

H.O.T. Problems Higher Order Thinking

Persevere with Problems **All of the triangular faces of the figure are congruent.**



9. What is the area of one of the triangular faces? the square face?

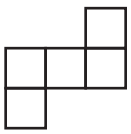
_____

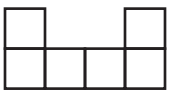
10. Use what you know about finding the surface area of a rectangular prism to find the surface area of the square pyramid.

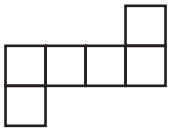
_____

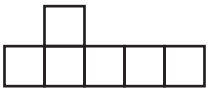
Georgia Test Practice

11. Which net can be used to make and find the surface area of a cube?

Ⓐ 

Ⓒ 

Ⓑ 

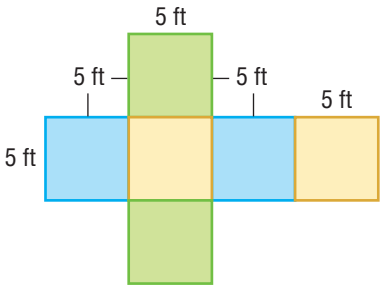
Ⓓ 

Name _____ My Homework _____

Extra Practice

Find the surface area of each rectangular prism.

12. 150 ft^2



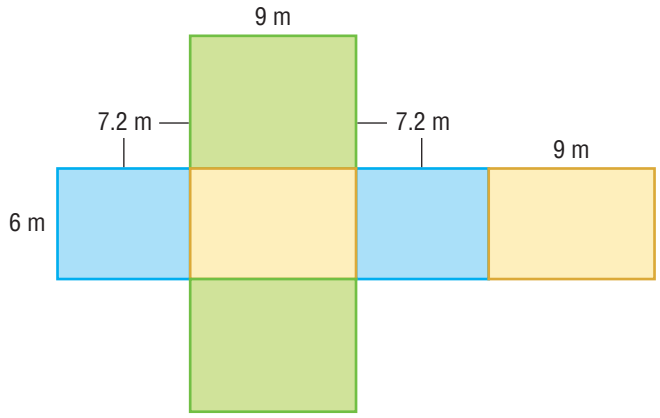
Homework Help

$2(5)(5) + 2(5)(5) + 2(5)(5)$

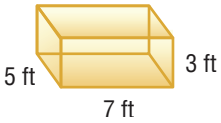
$= 50 + 50 + 50$

$= 150$

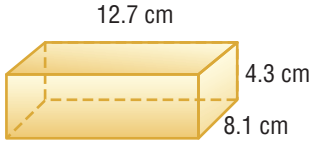
13. _____



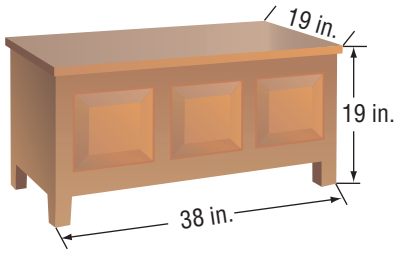
14. _____



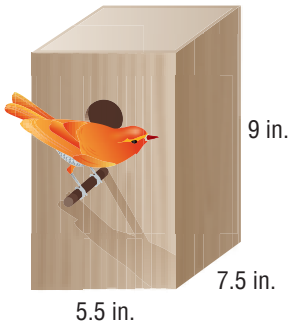
15. _____



16. Nadine is going to paint her younger sister's toy chest, including the bottom. What is the approximate surface area that she will paint? _____



17. CCSS **Identify Repeated Reasoning** Chrissy is making a bird nesting box for her backyard.



a. What is the surface area of the nesting box, including the hole? _____

b. What is the surface area if the width is doubled?

c. What is the surface area if the width is half as great?

Georgia Test Practice

18. Which measure can be classified as surface area?

Ⓐ the amount of water in a lake

Ⓑ the amount of land available to build a house

Ⓒ the amount of wrapping paper needed to cover a box

Ⓓ the height of a tree

19. Dilip is going to paint a shoebox to use for storage of his trading cards. The shoebox is 23 inches long, 10 inches wide, and 8 inches high. Find the surface area of the shoebox.

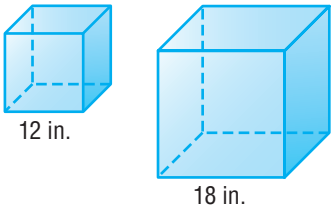
Ⓕ 246 square inches

Ⓖ 828 square inches

Ⓗ 988 square inches

Ⓘ 1,840 square inches

20. **Short Response** A company is experimenting with two new boxes for packaging merchandise. Each box is a cube with the side lengths shown. What is the ratio of the surface area of the smaller box to the surface area of the larger box?



Common Core Review

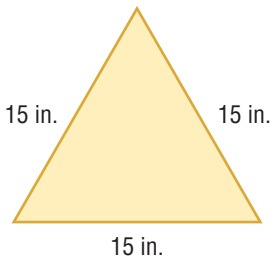
Add or multiply. MCC5.NBT.5, MCC4.NBT.4

21. $14 \times 16 =$ _____

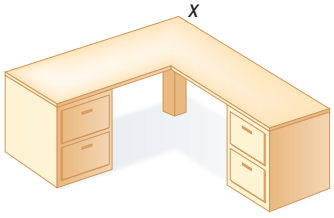
22. $72 + 62 + 84 =$ _____

23. $27 \times 63 =$ _____

24. Classify the triangle by the measure of its sides. Explain. MCC5.G.4



25. The top of Sarah's desk is a hexagon. One side of the desk is perpendicular to the other side. Angle x is created where the sides meet. What type of angle is angle x? MCC4.G.2



Inquiry Lab
Nets of Triangular Prisms

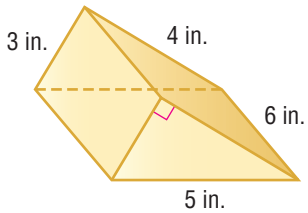
Inquiry **HOW is the area of a triangle related to the surface area of a triangular prism?**

Content Standards
MCC6.G.4
Mathematical Practices
1, 3, 4, 7

Packaging A computer hardware company packages batteries and cords in boxes shaped like triangular prisms. You can use nets and drawings to determine the surface area of the box.

Investigation

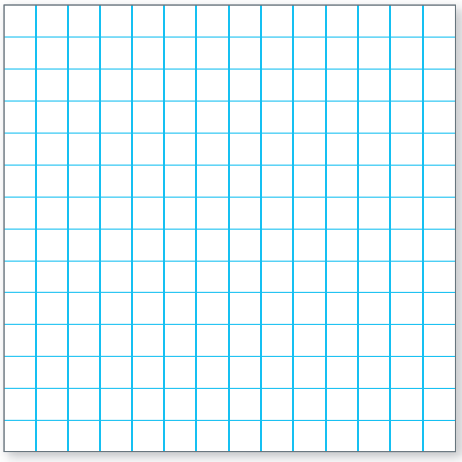
Use orthogonal drawings to find the surface area of a triangular prism. A *triangular prism* is a prism that has triangular bases.



Step 1 Find the dimensions of each side of the triangular prism from the orthogonal drawing.

Orthogonal Drawing							
View	**Drawing**	**Dimensions (in.)**	**Area of Face (in^2)**	**View**	**Drawing**	**Dimensions (in.)**	**Area of Face (in^2)**
Bases		base = 3 height = 4	$\frac{1}{2}(3 \times 4) = 6$	Bottom		length = 6 width = 5	$6 \times 5 = 30$
Left		length = 6 width = 3	$6 \times 3 = 18$	Right		length = 6 width = 4	$6 \times 4 = 24$

Step 2 Use grid paper to draw a net. Check the dimensions of each face using the information in the table.



Step 3 Add the area of each face to find the surface area of the figure. Remember, there are two bases.

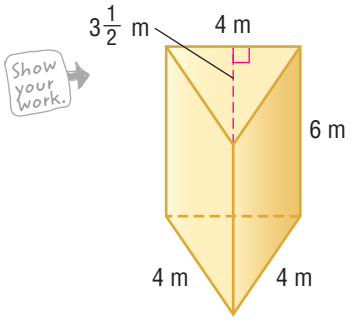
___ + ___ + ___ + ___ + ___ = ___

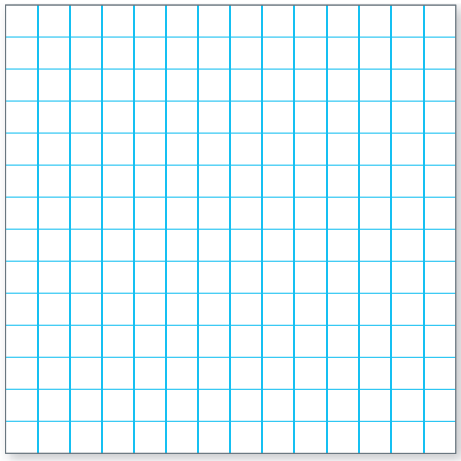
So, the surface area is ___ square units.

Collaborate

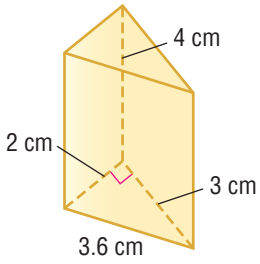
Model with Mathematics **Work with a partner. Use nets to determine the surface area of each prism. Draw a net of each prism on the provided grid paper.**

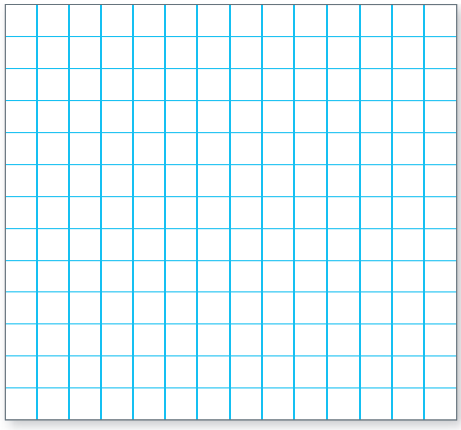
1. _____ m^2





2. _____ cm^2





Reflect

3. **Identify Structure** Explain how to find the surface area of a triangular prism, using only the dimensions of the figure. Use the dimensions in Exercise 2 to explain your answer.

_____

_____

4. Inquiry HOW is the area of a triangle related to the surface area of a triangular prism?

_____

_____

Surface Area of Triangular Prisms

What You'll Learn

Scan the lesson. Predict two things you will learn about finding the surface area of triangular prisms.

- _____
- _____

Essential Question

HOW is shape important when measuring a figure?

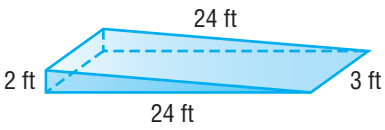
Common Core GPS

Content Standards
MCC6.G.4

Mathematical Practices
1, 2, 3, 4, 6

Real-World Link

Ramp Raj and his dad are building a ramp to move his dirt bike onto a trailer.



Fill in the table by drawing the sides of the ramp and naming the shape of each face.

	Face	Draw the Face	Shape of the Face
1.	Front		
2.	Back		
3.	Top		
4.	Bottom		
5.	Side		

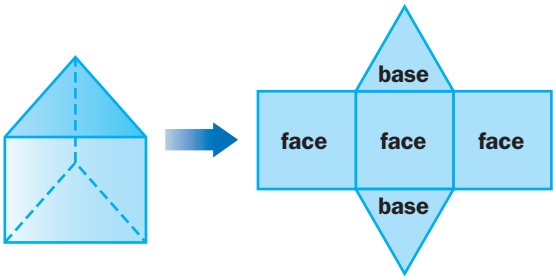
Key Concept

Surface Area of a Triangular Prism

Words

The surface area of a triangular prism is the sum of the areas of the two triangular bases and the three rectangular faces.

Model



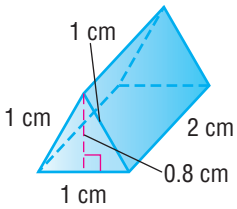
Work Zone

A triangular prism is a prism that has triangular bases. When the bases are equilateral triangles, the areas of the three rectangular faces are equal. You can use a net to find the surface area of a triangular prism.

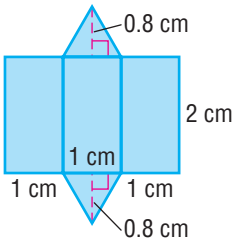
Example

Tutor

1. **Find the surface area of the triangular prism.**



To find the surface area of the triangular prism, find the area of each face and add.



area of each triangular base: $\frac{1}{2}(1)(0.8) = 0.4$

area of each rectangular face: $1(2) = 2$

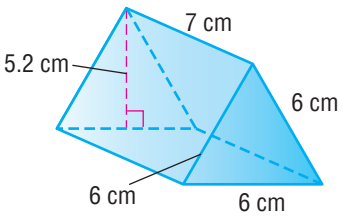
Add to find the surface area.

$0.4 + 0.4 + 2 + 2 + 2 = 6.8$ square centimeters

Show your work.

Got It? **Do this problem to find out.**

a. Find the surface area of the triangular prism.



a. _____

Surface Area of Other Triangular Prisms

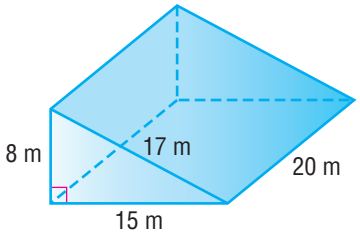
You can also find the surface area of any triangular prism by adding the areas of all the sides of the prism using an orthogonal drawing.

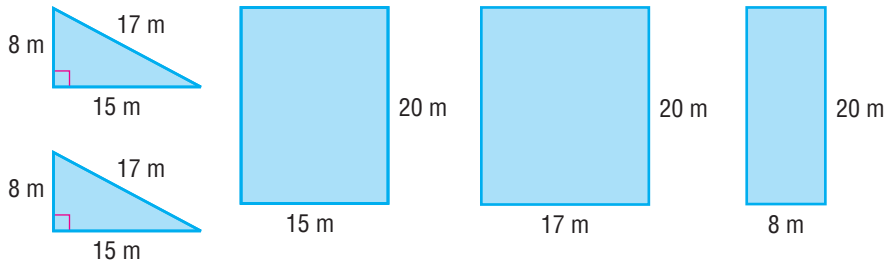
Example

Tutor

2. **Find the surface area of the triangular prism.**

Find the area of each face and add. For this prism, each rectangular face has a different area.





area of each triangular base: $\frac{1}{2}(15)(8) = 60$

area of the rectangular faces: $15(20) = 300$

$17(20) = 340$

$8(20) = 160$

Add to find the surface area.

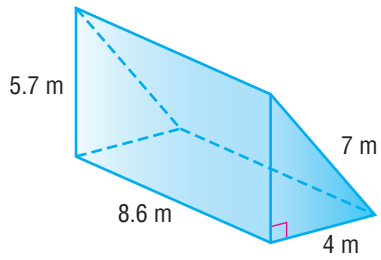
$60 + 60 + 300 + 340 + 160 = 920$ square meters

Got It? Do this problem to find out.

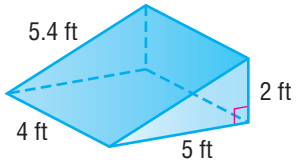
Show your work.

Find the surface area of each triangular prism.

b.



c.

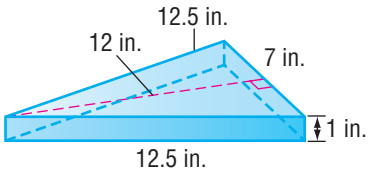


b. _____

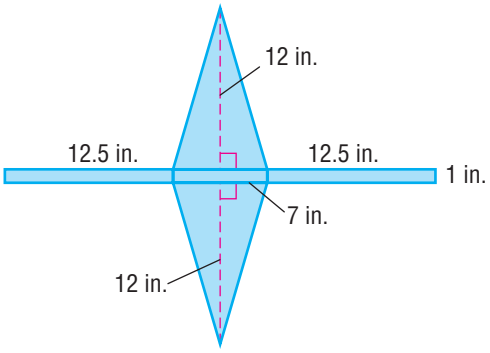
c. _____

Example

3. **A bakery boxes pie pieces in a triangular prism box, as shown. Find the amount of cardboard used to make a box for a slice of pie.**



Sketch and label the bases and faces of the triangular prism. Then add the areas of the polygons.

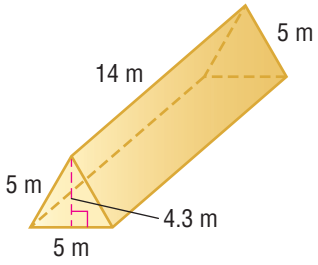


$$\text{Surface area} = 2\left(\frac{1}{2} \cdot 7 \cdot 12\right) + 2(1 \cdot 12.5) + (1 \cdot 7)$$
$$= 84 + 25 + 7 \text{ or } 116$$

So, 116 square inches of cardboard is needed to make a box.

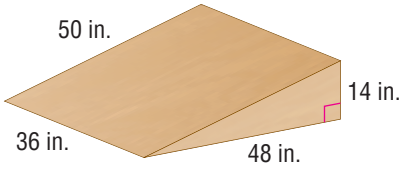
Guided Practice

1. Find the surface area of the triangular prism. (Examples 1–2) _____



Show your work.

2. A skateboarding ramp is in the shape of a triangular prism. If the entire ramp is to be painted, what is the surface area to be painted? (Example 3) _____



3. **Building on the Essential Question** How is the area of a rectangle related to the surface area of a triangular prism? _____

Rate Yourself!

How confident are you about surface area of triangular prisms? Check the box that applies.

For more help, go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

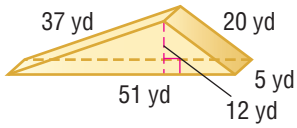
Name _____ My Homework _____

Independent Practice

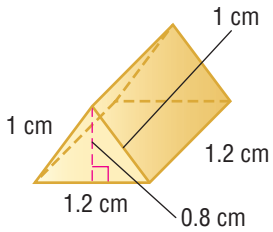
Go online for Step-by-Step Solutions eHelp

Find the surface area of each triangular prism. (Examples 1–2)

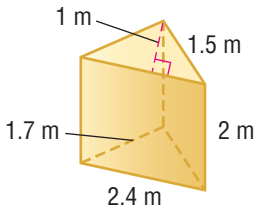
1. _____



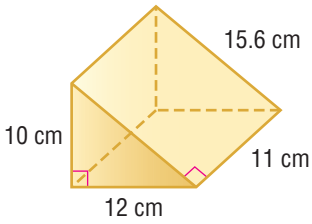
2. _____



3 _____



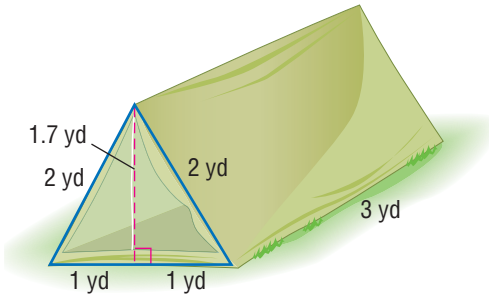
4. _____



5 A tent is in the shape of a triangular prism. About how much canvas, including the floor, is used to make the tent? (Example 3)

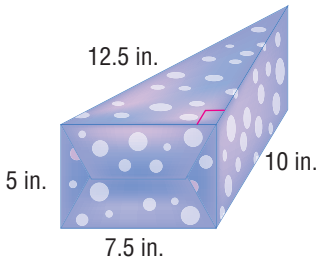
_____

Show your work.



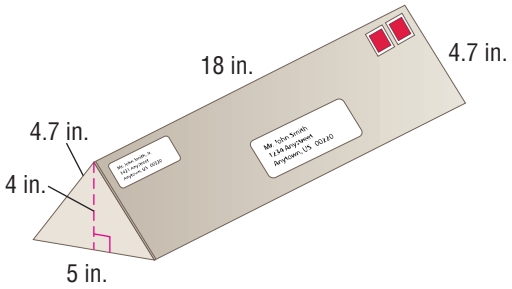
6. A decorative gift box is in the shape of a triangular prism as shown. What is the surface area of the box? (Example 3)

_____

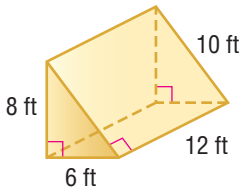


7. A mailer for posters is a triangular prism as shown. Find the surface area of the mailer. (Example 3)

_____



8. **Multiple Representations** The figure shows the dimensions of a triangular prism.



a. **Models** Draw a model of the faces and bases of the triangular prism.

Show your work.

b. **Words** Describe the triangular prism. _____

_____

_____

c. **Numbers** Find the surface area of the triangular prism using addition.

_____

9. The surface area of a right triangular prism is 228 square inches. The base is a right triangle with a base height of 6 inches and a base length of 8 inches. The length of the third side of the base is 10 inches. Find the height of the prism. _____

H.O.T. Problems Higher Order Thinking

10. **Reason Abstractly** Describe the dimensions of a triangular prism that has a surface area between 550 square inches and 700 square inches.

_____

_____

11. **Persevere with Problems** Sketch and label two triangular prisms such that one has a greater volume and the other has a greater surface area.

_____

_____

_____

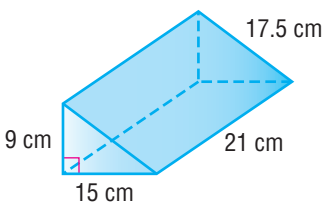
_____

Georgia Test Practice

12. Find the surface area of the prism to the nearest whole number.

Ⓐ 1,471 cm^2 Ⓒ 1,007 cm^2

Ⓑ 945 cm^2 Ⓓ 777 cm^2



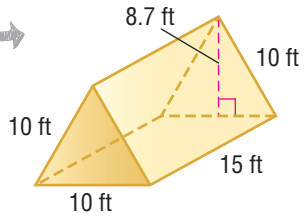
Name _____ My Homework _____

Extra Practice

Be precise **Find the surface area of each triangular prism. Round to the nearest tenth if necessary.**

13. 537 ft^2

Homework Help

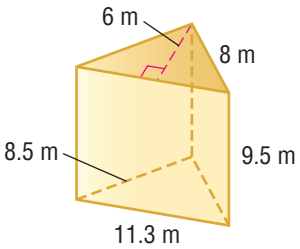


area of each base: $\frac{1}{2} \cdot 10 \cdot 8.7 = 43.5\ ft^2$

area of each face: $15 \cdot 10 = 150\ ft^2$

surface area $= 2(43.5) + 3(150)$
$= 537\ ft^2$

14. 331.9 m^2

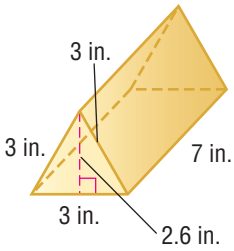


area of each base: $\frac{1}{2} \cdot 11.3 \cdot 6 = 33.9\ m^2$

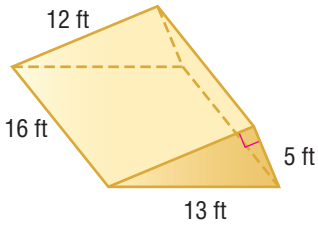
areas of faces: $11.3 \cdot 9.5 = 107.35\ m^2$
$8.5 \cdot 9.5 = 80.75\ m^2$
$8 \cdot 9.5 = 76\ m^2$

surface area $= 33.9 + 33.9 + 107.35 +$
$80.75 + 76$ or $331.9\ m^2$

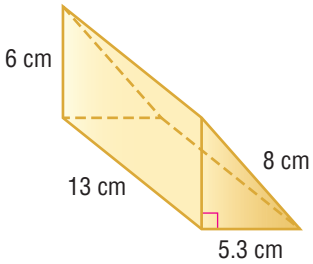
15. _____



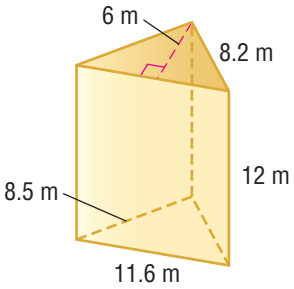
16. _____



17. _____

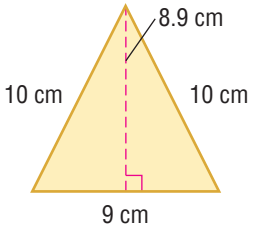


18. _____



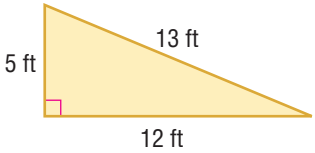
Copy and Solve **Find the surface area of each triangular prism using the base triangles shown. Show your work on a separate piece of paper.**

19.



height of prism: 12 cm

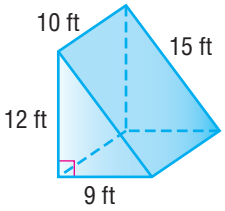
20.



height of prism: 15 ft

Georgia Test Practice

21. What is the surface area of the prism shown below?

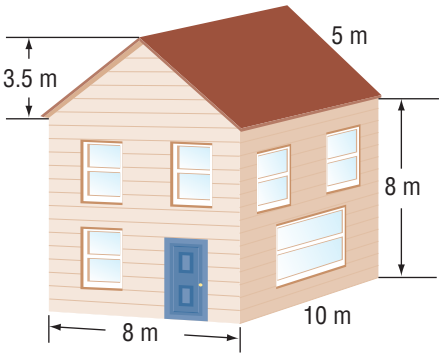


Ⓐ 348 ft^2
Ⓒ 414 ft^2
Ⓑ 360 ft^2
Ⓓ 468 ft^2

22. **Short Response** A triangular prism has bases that each have an approximate area of 173 square centimeters. The triangles measure 20 centimeters on each side and the prism is 4 centimeters high. What is the surface area of the prism?

_____

23. The attic of the house is a wooden surface. How many square meters of wood are needed to build the roof and floor of the attic?

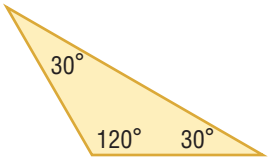


Ⓕ 140 m^2
Ⓖ 158 m^2
Ⓗ 180 m^2
Ⓘ 640 m^2

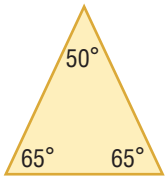
Common Core Review

Identify each triangle as *acute*, *right*, or *obtuse*. MCC5.G.4

24. _____



25. _____



26. _____

27. A certain two-dimensional figure has two pairs of parallel lines, four right angles, and four congruent sides. What is the figure? MCC4.G.2

_____

28. The showcase floor at Murphy Motors is divided into four equal sections. Find the area of Motorcycle Madness if the square showcase floor has a side length of 20 feet. MCC4.MD.3

_____

Inquiry Lab
Nets of Pyramids

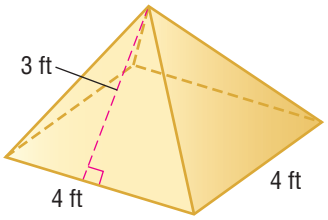
Inquiry **HOW is the area of a triangle related to the surface area of a square pyramid?**

Content Standards
MCC6.G.4
Mathematical Practices
1, 3, 4

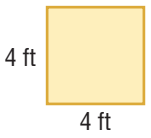
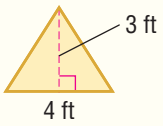
Art Anderson Art is designing a paper weight that is shaped like a square pyramid.

Investigation

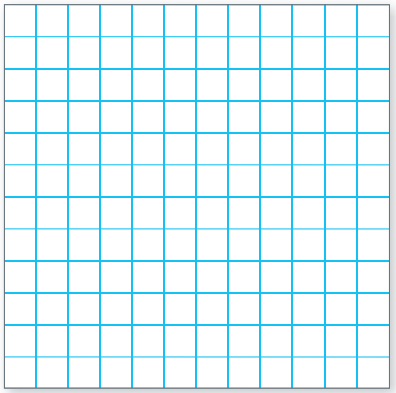
Use orthogonal drawings to find the surface area of a square pyramid. A *square pyramid* is a three-dimensional figure with a square base and four triangular faces.



Step 1 Find the dimensions of each side of the square pyramid from the orthogonal drawing.

Orthogonal Drawing			
View	**Drawing**	**Dimensions (ft)**	**Area of Face (ft^2)**
Bases		length = 4 height = 4	$4 \times 4 = 16$
Triangular Faces		height = 3 base = 4	$\frac{1}{2}(3 \times 4) = 6$

Step 2 Use grid paper to draw a net. Check the dimensions of each face using the information in the table.



Step 3 Add the area of each face to find the surface area of the figure. Remember, there are four triangular faces.

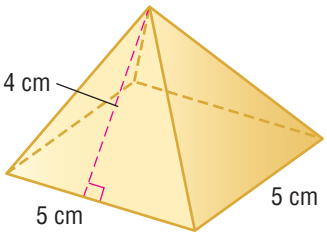
$\square + \square \times \square = \square$

So, the surface area is $\square$ square units.

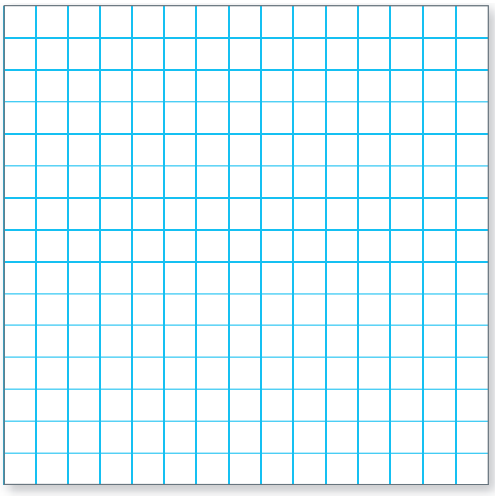
Collaborate

Model with Mathematics **Work with a partner. Use nets to determine the surface area of each pyramid. Draw a net of each pyramid on the provided grid paper.**

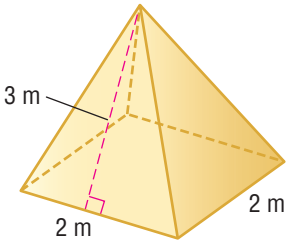
1. _____ cm^2

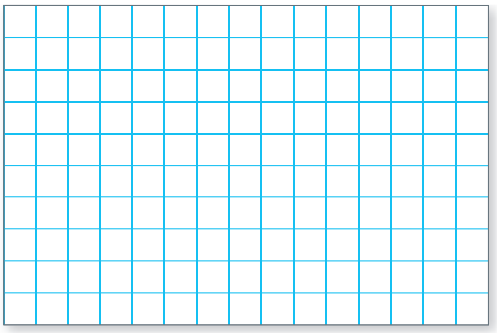


Show your work.



2. _____ m^2





Reflect

3. **Construct an Argument** Explain how to find the surface area of a square pyramid, without creating a net. Use the dimensions in Exercise 1 to explain your answer.

_____

_____

_____

_____

4. HOW is the area of a triangle related to the surface area of a square pyramid? _____

_____

_____

Lesson 5

Surface Area of Pyramids

What You'll Learn

Scan the lesson. Predict two things you will learn about finding the surface area of pyramids.

- _____
- _____

Essential Question

HOW is shape important when measuring a figure?

Vocabulary

pyramid
vertex
base
lateral face
slant height

Common Core GPS

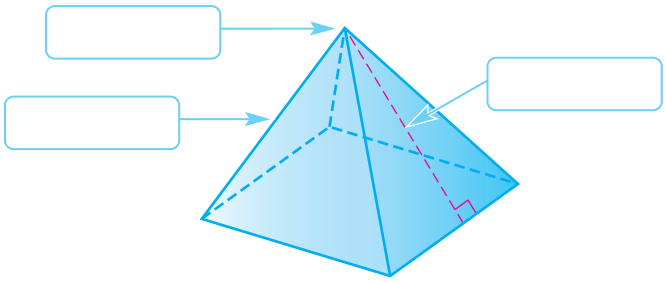
Content Standards
MCC6.G.4

Mathematical Practices
1, 3, 4, 6, 7

Vocabulary Start-Up

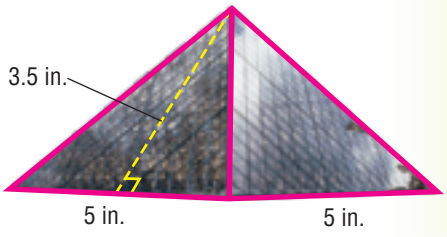
A **pyramid** is a three-dimensional figure with at least three triangular sides that meet at a common **vertex** and only one **base** that is a polygon. The triangular sides of a square pyramid are called the **lateral faces**. The **slant height** is the height of each lateral face.

Fill in the blanks on the diagram below with vocabulary words.



Real-World Link

Museum Claude made a model of the large pyramid in front of the Louvre museum. His model is shown.



1. Draw the faces of the pyramid.

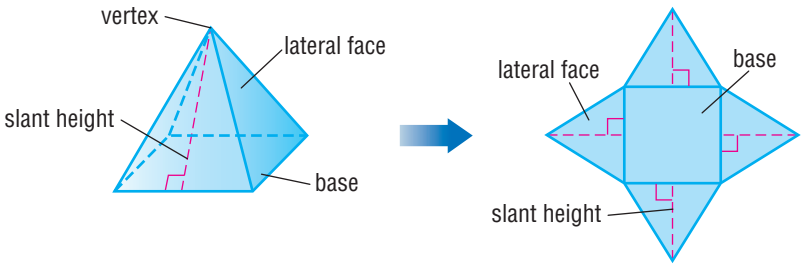
base | lateral face | lateral face | lateral face | lateral face

Key Concept

Surface Area of a Pyramid

Words The surface area of a pyramid is the sum of the area of the base and the areas of the lateral faces.

Model



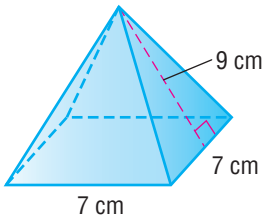
Some pyramids have square or rectangular bases. You can use a net to find the surface area of a pyramid.

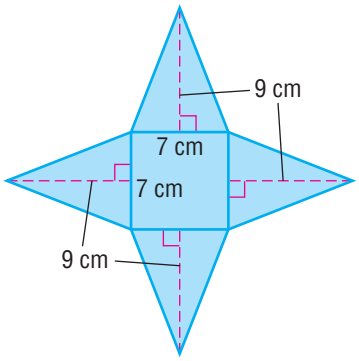
Example

Tutor

1. **Find the surface area of the pyramid.**

Use a net to find the area of each face and then add.





area of base: $7(7) = 49$

area of each triangular side: $\frac{1}{2}(7)(9) = 31.5$

Add to find the surface area.

$49 + 31.5 + 31.5 + 31.5 + 31.5 = 175$ square centimeters

Work Zone

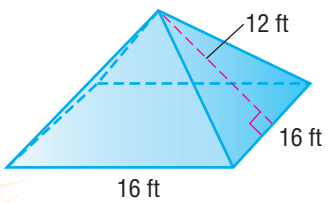
Show your work.

a. _____

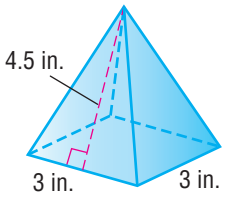
b. _____

Got It? **Do these problems to find out.**

a.



b.



Surface Area of Pyramids with Triangular Bases

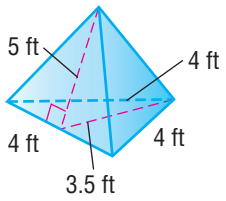
A triangular pyramid has one triangular base, and three triangular faces. If the base is an equilateral triangle, all three lateral faces are congruent. If the sides of the base triangle are different lengths, the areas of the lateral faces will also vary.

Example

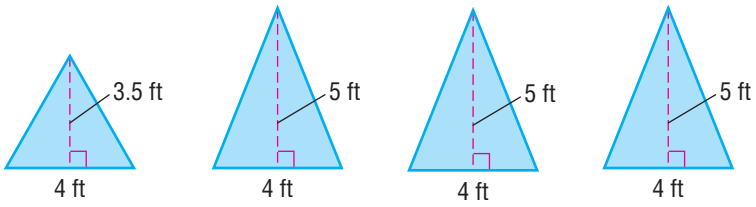
Tutor

2. **Find the surface area of the pyramid.**

Find the area of each face and add. The triangular base is an equilateral triangle because all three sides are 4 feet long.



base **lateral faces**



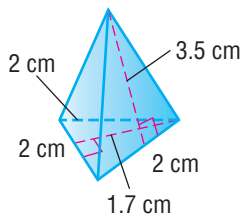
area of base: $\frac{1}{2}(4)(3.5) = 7$

area of each lateral face: $\frac{1}{2}(4)(5) = 10$

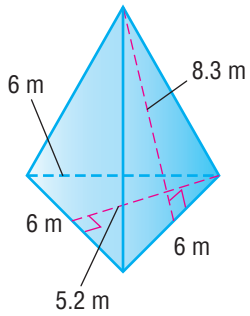
Add to find the surface area.
$7 + 10 + 10 + 10 = 37$ square feet

Got It? **Do these problems to find out.**

c.



d.



Show your work.

c. _____

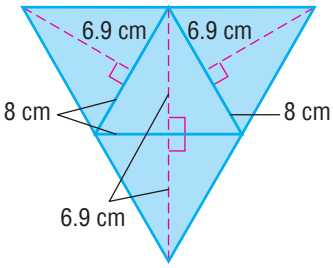
d. _____

Example

3. **A pyramid puzzle has all sides that are equilateral triangles. Each triangle has side lengths of 8 centimeters. The slant height is 6.9 centimeters. Find the surface area of the puzzle.**

Create a net and then use it to find the surface area of the pyramid.

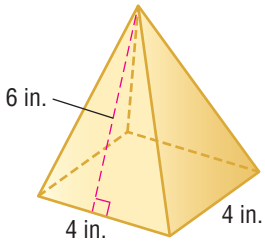
Each face has an area of $\frac{1}{2}(8)(6.9)$ or 27.6 square centimeters. So, the surface area of the puzzle is $4 \cdot 27.6$ or 110.4 square centimeters.



Guided Practice

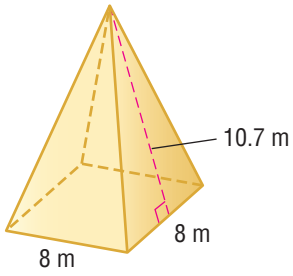
Find the surface area of each pyramid. (Examples 1–2)

1.

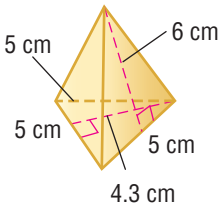


Show your work.

2.



3.



4. Pyramid-shaped gift boxes have square bases that measure 5 inches on each side. The slant height is 6.5 inches. How much cardboard is used to make each box? (Example 3)

5. **Building on the Essential Question** How do you use the area of a triangle to find the surface area of a triangular pyramid?

Rate Yourself!

☐ I understand surface area of pyramids.

Great! You're ready to move on!

☐ I still have questions about surface area of pyramids.

No Problem! Go online to access a Personal Tutor.

FOLDABLES Time to update your Foldable!

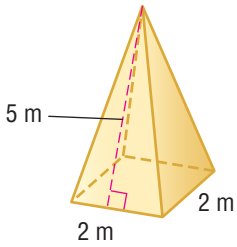
Name _____ My Homework _____

Independent Practice

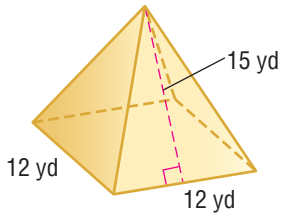
Go online for Step-by-Step Solutions eHelp

Find the surface area of each pyramid. (Examples 1–2)

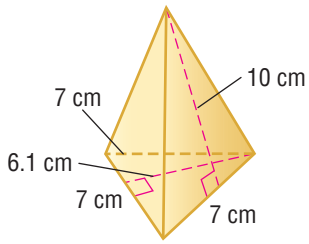
1.



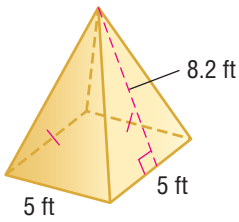
2.



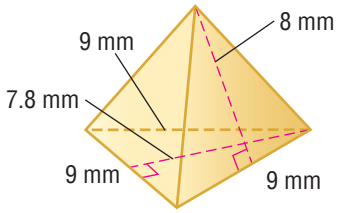
3



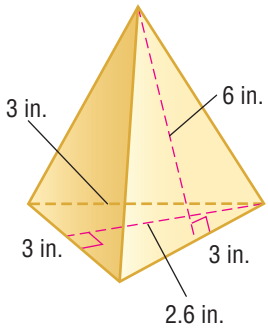
4.



5.



6.



7 A tea bag is shaped like a square pyramid with the base measuring 4 centimeters on each side. The slant height is 4.5 centimeters. How much mesh is used to create the tea bag? (Example 3)

Show your work.

8. An earring design is shaped like a triangular pyramid. All the faces are equilateral triangles with side lengths of 14 millimeters. The slant height is 12.1 millimeters. What is the surface area of the earring? (Example 3)

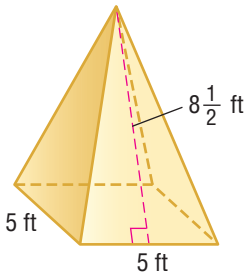
9. An acting award is a square pyramid with a base that measures 6 inches on each side. The slant height is 8 inches. What is the surface area of the award? (Example 3)

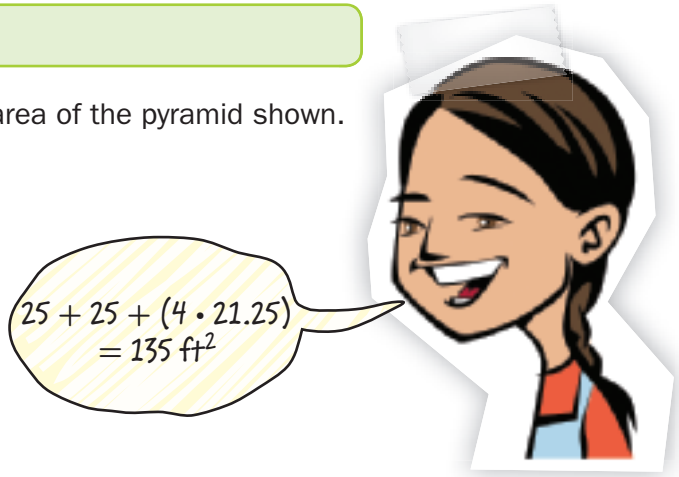
10. **Identify Structure** Refer to the figures listed in the table. Determine the number of faces the figure has of each two-dimensional shape. Explain.

Figure	Rectangular Faces	Triangular Faces
Rectangular Prism		
Triangular Prism		
Square Pyramid		
Triangular Pyramid		

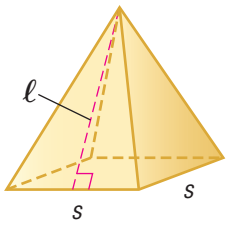
H.O.T. Problems Higher Order Thinking

11. **Find the Error** Pilar is finding the surface area of the pyramid shown. Find her mistake and correct it.





12. **Persevere with Problems** The *lateral surface area L.A.* of a pyramid is the area of its lateral faces. Use the square pyramid at the right to complete each step to find the lateral surface area of any pyramid.



$L.A. = \frac{1}{2} s\ell +$ _____ Lateral surface area

$= \frac{1}{2}$ (_____)ℓ Distributive Property

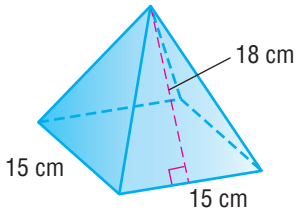
$=$ _____ Perimeter of base: $P = s + s + s + s$

Georgia Test Practice

13. Find the surface area of the pyramid.

Ⓐ 360 cm^2 Ⓒ 765 cm^2

Ⓑ 540 cm^2 Ⓓ 1,305 cm^2

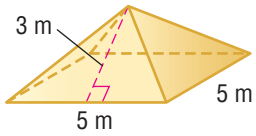


Name _____ My Homework _____

Extra Practice

Find the surface area of each pyramid.

14. 55 m^2



Homework Help

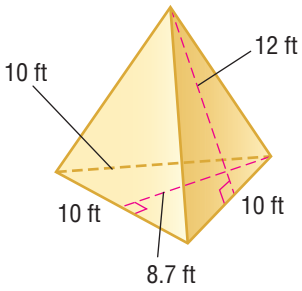
area of base: $5 \cdot 5 = 25\ m^2$

area of each face: $\frac{1}{2} \cdot 5 \cdot 3 = 7.5\ m^2$

surface area $= 25 + (4 \cdot 7.5)$

$= 25 + 30$ or $55\ m^2$

15. 223.5 ft^2



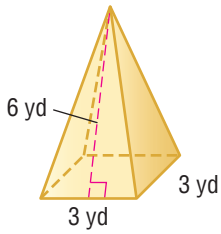
area of base: $\frac{1}{2} \cdot 10 \cdot 8.7 = 43.5\ ft^2$

area of each face: $\frac{1}{2} \cdot 10 \cdot 12 = 60\ ft^2$

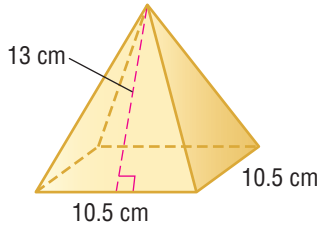
surface area $= 43.5 + (3 \cdot 60)$

$= 43.5 + 180$ or $223.5\ ft^2$

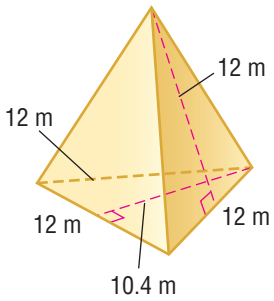
16. _____



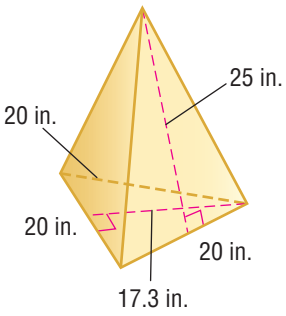
17. _____



18. _____



19. _____



20. A paper model of the Khafre pyramid in Egypt has a square base 7.2 centimeters on each side. The slant height is 6 centimeters. How much paper was used to make the model?

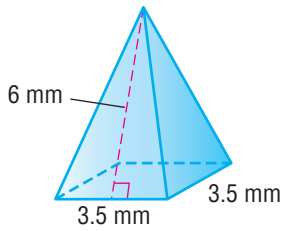
_____

21. CCSS **Be Precise** A triangular pyramid has a surface area of 336 square inches. It is made up of equilateral triangles with side lengths of 12 inches. What is the slant height?

_____

Georgia Test Practice

22. What is the surface area of the pyramid shown below?

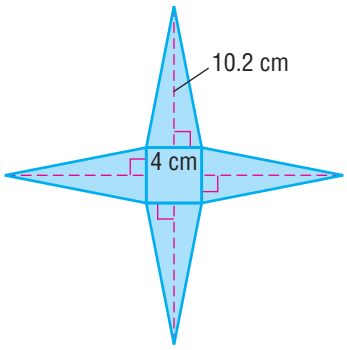


Ⓐ 24.5 mm^2
Ⓑ 42 mm^2
Ⓒ 54.25 mm^2
Ⓓ 96.25 mm^2

23. **Short Response** A pyramid has a base that is an equilateral triangle. The area of the base is 209.6 square inches and the sides measure 22 inches. The slant height of the pyramid is 14 inches. What is the surface area?

_____

24. A salt shaker is in the shape of a square pyramid. The net is shown below. What is the surface area of the salt shaker?



Ⓕ 36.4 cm^2
Ⓖ 40.8 cm^2
Ⓗ 81.6 cm^2
Ⓘ 97.6 cm^2

Common Core Review

Divide. MCC5.NBT.6

25. 240 ÷ 10 = _____

26. 3,600 ÷ 36 = _____

27. 4,800 ÷ 80 = _____

28. Jalisa and two of her friends are sharing the cost of a taxi ride to the airport. The taxi ride costs $24.75. How much will each person pay? MCC5.NBT.7

_____

29. How many centimeters are equal to 0.05 meters? MCC5.MD.1

_____

fstop/Punchstock

21ST CENTURY CAREER in Design

Interior Designer

Do you like coming up with new ways to decorate your room, or are you always rearranging the furniture? You could have a career doing just that by becoming an interior designer. Interior designers plan the interior space and furnishings of homes, offices, and other places. Their designs are based on the client's specifications, tastes, and budget. Interior designers are responsible for recommending color schemes, furniture, lighting, and remodeling options. Many interior designers also develop their own product lines such as furniture, bedding, and accessories.

Photodisc/Getty Images(t); Aaron Cobbett/Stone/Getty Images(b)

College & Career READINESS

Explore college and careers at ccr.mcgraw-hill.com

Is This the Career for You?

Are you interested in a career as an interior designer? Take some of the following courses in high school.

- Algebra
- Geometry
- Interior Design
- Intro to CAD

Turn the page to find out how math relates to a career in Design.

You be the Designer!

Use the labeled figures to solve each problem. Round to the nearest tenth if necessary.

1. A client wants to buy the rectangular ottoman with the most storage area inside. Which one should she choose? Explain your reasoning. _____

2. Find the volume of the paisley blanket chest. _____

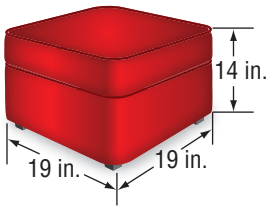
3. What is the volume of the toy chest? How does it compare to the volume of the paisley blanket chest? _____

4. A designer is having the red ottoman reupholstered. Find the surface area to estimate the amount of fabric needed. _____

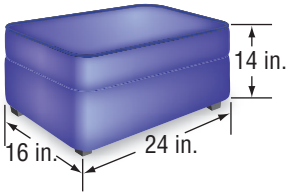
5. What is the surface area of the purple ottoman? _____

6. How much greater is the surface area of the paisley blanket chest than the surface area of the toy chest? _____

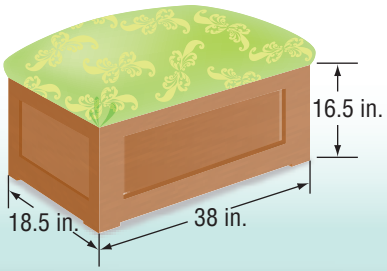
Red Ottoman



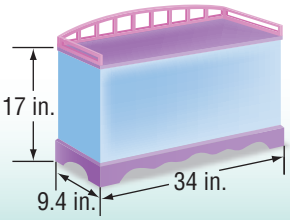
Purple Ottoman



Blanket Chest



Toy Chest



Career Project

It's time to update your career portfolio! Use grid paper to make a scale drawing of a room in your home. Model the furniture using squares, rectangles, and triangles drawn to scale. Cut out each shape and use them to create different room arrangements. Then, tape the pieces onto the grid paper. Describe the room's color scheme and style.

_____

_____

_____

_____

Do you think you would enjoy a career as an interior designer? Why or why not?

_____

_____

_____

_____

Chapter Review

Vocabulary Check

Complete each sentence using the vocabulary list at the beginning of the chapter. Then circle the word that completes the sentence in the word search.

1. A figure with length, width, and height is a _____.
2. _____ is the sum of the area of all the faces of a three-dimensional figure.
3. The amount of space inside a three-dimensional figure is its _____.
4. A prism that has triangular bases is a _____.
5. A _____ is a prism that has rectangular bases.
6. Volume is measured in _____.
7. The point where three or more faces intersect is the _____.
8. The _____ is the height of each lateral face.
9. Any face that is not a base is a _____.

V	R	O	D	I	S	X	W	A	J	A	K	S	M	K	H	N	Y	P	K	F	V	T
G	T	N	G	B	Z	W	G	E	Q	J	U	R	E	A	G	K	T	C	B	G	S	R
X	T	O	E	X	L	A	T	E	R	A	L	F	A	C	E	T	E	A	P	D	T	I
E	G	H	I	E	H	Y	L	I	T	J	S	T	I	N	U	C	I	B	U	C	X	A
F	M	H	G	F	G	C	H	H	V	F	O	T	V	E	X	K	X	Z	U	I	E	N
E	R	U	G	I	F	L	A	N	O	I	S	N	E	M	I	D	E	E	R	H	T	G
A	K	J	L	B	E	L	M	A	E	R	A	E	C	A	F	R	U	S	F	K	R	U
U	G	U	K	O	H	H	U	K	D	K	L	P	N	T	J	K	Q	Y	H	E	E	L
V	F	O	M	Q	V	S	T	K	I	L	N	I	O	Y	S	B	R	Z	Q	K	V	A
R	Y	J	S	H	U	W	D	N	M	B	T	P	B	O	T	S	U	L	F	C	J	R
R	E	C	T	A	N	G	U	L	A	R	P	R	I	S	M	U	D	V	C	C	Y	P
H	K	I	A	D	Z	V	G	M	U	L	W	W	Q	R	I	K	R	A	K	D	M	R
P	Z	T	B	Y	U	X	B	S	F	N	S	O	K	E	D	X	G	C	F	G	N	I
N	I	W	Y	Q	A	Z	K	E	D	V	U	O	L	U	L	H	N	B	J	O	S	S
I	A	H	P	V	J	A	K	O	W	N	Z	W	E	I	U	D	Q	Q	H	V	I	M

Key Concept Check

Use Your FOLDABLES

Use your Foldable to help review the chapter.

Tape here

Tab 1

Real-World Examples

Formulas

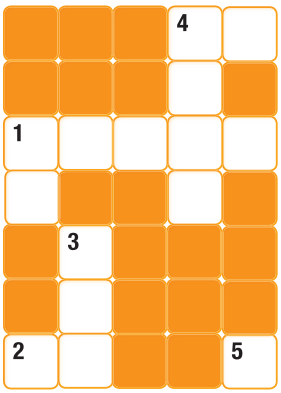
Model

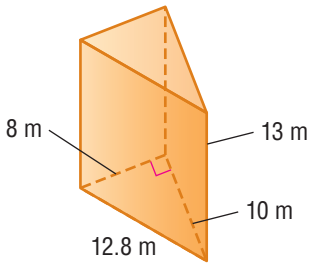
Tab 2

Tape here

Got it?

Use the figure provided to complete the cross number puzzle.





Across

1. surface area of the prism
2. height of the base triangle
4. height of the prism
5. length of the base triangle

Down

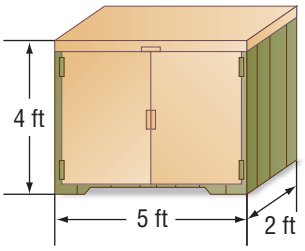
1. area of the base
3. volume of the prism
4. length of one side of the base triangle

Problem Solving

1. An office building is built in the shape of a rectangular prism. It has a length of 168 yards, a width of 115 yards, and a height 96 yards. What is the volume of the building? (Lesson 1)

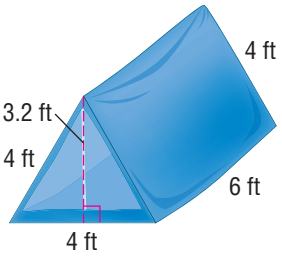
2. Liza is researching packaging options for her shop. She wants to know the volume of a triangular prism 9 inches tall with a triangular base that is 3 inches by 2 inches. (Lesson 2)

3. **Use Math Tools** Justin is building a storage trunk like the one shown. How much wood is needed to make the trunk? (Lesson 3)



4. A baker needs to put icing on a rectangular cake. The cake is 14 inches long, 12 inches wide, and 4 inches tall. What is the surface area of the cake, not including the bottom? (Lesson 3)

5. Stephanie was making a tent like the one shown. How much fabric does she need to make the tent? (Lesson 4)



6. **Reason Abstractly** A paper die has sides that are all equilateral triangles. Each triangle has a side length of 1.5 cm. The slant height is 1.3 cm. Find the surface area of the die. (Lesson 5)

Reflect

Answering the Essential Question

Use what you learned about volume and surface area to complete the graphic organizer.

Essential Question

HOW is shape important when measuring a figure?

	Draw it.	How do you find the volume?	How do you find the surface area?
rectangular prism			
triangular prism			

Answer the Essential Question. HOW is shape important when measuring a figure?