LESSON 9.4

Solving Surface Area Problems

FL 7.G.2.6

Solve real-world and mathematical problems involving . . . surface area of . . . three-dimensional objects composed of . . . cubes and right prisms.

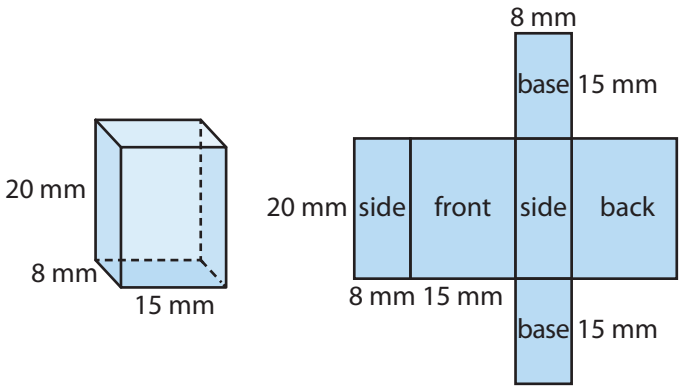
ESSENTIAL QUESTION

How can you find the surface area of a figure made up of cubes and prisms?

EXPLORE ACTIVITY FL 7.G.2.6

Modeling Surface Area of a Prism

The surface area of a three-dimensional figure is the sum of the areas of all its surfaces. You know how to use the net of a figure to find its surface area. Now you will discover a formula that you can use.



A The lateral area L of a prism is the area of all faces except the bases.

$L = 2(\_\_\_\_\_) + 2(\_\_\_\_\_) = \_\_\_\_\_$.

B The area B of each base is _____.

C The surface area S of the prism is the sum of the lateral area L and the total area of the bases, or _____.

Reflect

1. **Analyze Relationships** Use the net above to answer this question: How does the product of the perimeter P of the base of the prism and the height h of the prism compare to the lateral area L?

2. **Critical Thinking** How can you express the surface area S of the prism in terms of P, h, and B? Use your answer to Question 1.

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Finding the Surface Area of a Prism

Given a prism's dimensions, you can use a formula to find the surface area.

Surface Area of a Prism

The surface area S of a prism with base perimeter P, height h, and base area B is $S = Ph + 2B$.

My Notes

EXAMPLE 1

Real World

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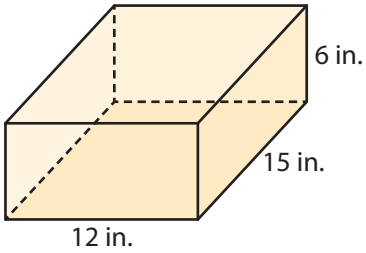
Erin is making a jewelry box of wood in the shape of a rectangular prism. The jewelry box will have the dimensions shown. She plans to spray paint the exterior of the box. How many square inches will she have to paint?



STEP 1 Make a sketch of the box. Drawing a diagram helps you understand and solve the problem.

STEP 2 Identify a base, and find its area and perimeter.

Any pair of opposite faces can be the bases. For example, you can choose the bottom and top of the box as the bases.

$B = \ell \times w$

$= 12 \times 15$

$= 180$ square inches

$P = 2(12) + 2(15)$

$= 24 + 30$

$= 54$ inches

STEP 3 Identify the height, and find the surface area.

The height h of the prism is 6 inches. Use the formula to find the surface area.

$S = Ph + 2B$

$S = 54(6) + 2(180) = 684$ square inches

Erin will have to spray paint 684 square inches of wood.

Math Talk
Mathematical Practices

How can you express the formula for the surface area S of a rectangular prism in terms of its dimensions ℓ, w, and h?

YOUR TURN

3. A brand of uncooked spaghetti comes in a box that is a rectangular prism with a length of 9 inches, a width of 2 inches, and a height of $1\frac{1}{2}$ inches.

What is the surface area of the box? _____

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Finding the Surface Area of a Composite Solid

A composite solid is made up of two or more solid figures. To find the surface area of a composite solid, find the surface area of each figure. Subtract any area not on the surface.

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EXAMPLE 2 Problem Solving

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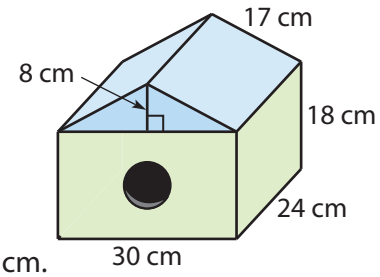
Daniel built the birdhouse shown. What was the surface area of the birdhouse before the hole was drilled?



Analyze Information

Identify the important information.

- The top is a triangular prism with $h = 24$ cm. The base is a triangle with height 8 cm and base 30 cm.
- The bottom is a rectangular prism with $h = 18$ cm. The base is a 30 cm by 24 cm rectangle.
- One face of each prism is not on the surface of the figure.

Formulate a Plan

Find the surface area of each prism.

Add the areas. Subtract the areas of the parts not on the surface.

Solve

Find the area of the triangular prism.

Perimeter $= 17 + 17 + 30 = 64$ cm; Base area $= \frac{1}{2}(30)(8) = 120$ cm^2

Surface area $= Ph + 2B$

$= 64(24) + 2(120) = 1{,}776$ cm^2

Find the area of the rectangular prism.

Perimeter $= 2(30) + 2(24) = 108$ cm; Base area $= 30(24) = 720$ cm^2

Surface area $= Ph + 2B$

$= 108(18) + 2(720) = 3{,}384$ cm^2

Add. Then subtract twice the areas of the parts not on the surface.

Surface area $= 1{,}776 + 3{,}384 - 2(720) = 3{,}720$ cm^2

The surface area before the hole was drilled was 3,720 cm^2.

Justify and Evaluate

You can check your work by using a net to find the surface areas.

Math Talk
Mathematical Practices

How could you find the surface area by letting the front and back of the prism be the bases?

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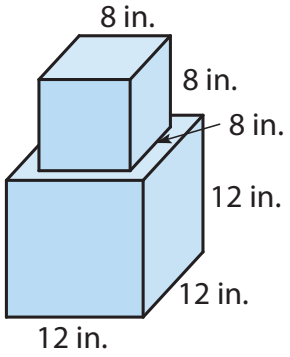
YOUR TURN

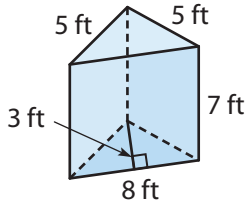
4. Dara is building a plant stand. She wants to stain the plant stand, except for the bottom of the larger prism. Find the surface area of the part of the plant stand she will stain. _____



Guided Practice

Find the surface area of each solid figure. (Examples 1 and 2)

1.



Perimeter of base = _____

Height = _____

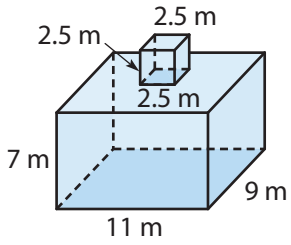
Base area = _____

Surface area:

S = (_____)(_____) + 2(_____)

= _____

2.



Surface area of cube:

S = _____

Surface area of rectangular prism:

S = _____

Overlapping area: A = _____

Surface area of composite figure:

= _____ + _____ − 2 (_____) =

_____ m^2

ESSENTIAL QUESTION CHECK-IN

3. How can you find the surface area of a composite solid made up of prisms?

_____

_____

_____

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Name _____ Class _____ Date _____

9.4 Independent Practice

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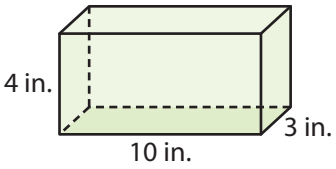
4. Carla is wrapping a present in the box shown. How much wrapping paper does she need, not including overlap?



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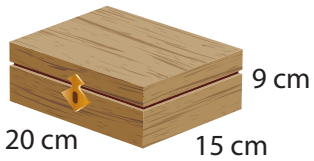
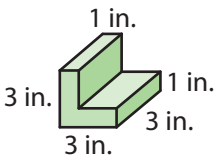
5. Dmitri wants to cover the top and sides of the box shown with glass tiles that are 5 mm square. How many tiles does he need?



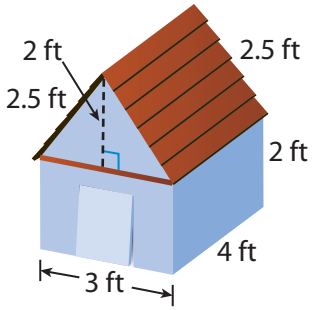
_____

6. Shera is building a cabinet. She is making wooden braces for the corners of the cabinet. Find the surface area of each brace.



_____

7. The doghouse shown has a floor, but no windows. Find the total surface area of the doghouse, including the door.



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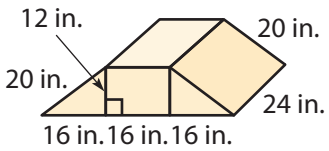
Eddie built the ramp shown to train his puppy to do tricks. Use the figure for 8–9.



8. **Analyze Relationships** Describe two ways to find the surface area of the ramp.

_____

_____

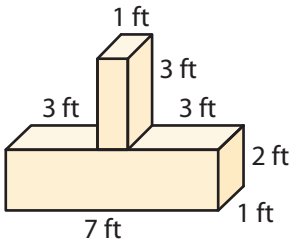
_____

_____

9. What is the surface area of the ramp?

_____

Marco and Elaine are building a stand like the one shown to display trophies. Use the figure for 10–11.



10. What is the surface area of the stand?

_____

11. **Critique Reasoning** Marco and Elaine want to paint the entire stand silver. A can of paint covers 25 square feet and costs $6.79. They set aside $15 for paint. Is that enough? Explain.

_____

_____

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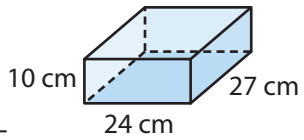
12. Henry wants to cover the box shown with paper without any overlap. How many square centimeters will be covered with paper?



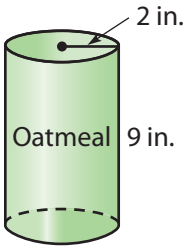
13. **What If?** Suppose the length and width of the box in Exercise 12 double. Does the surface area S double? Explain.

H.O.T. FOCUS ON HIGHER ORDER THINKING

Work Area

14. **Persevere in Problem Solving** Enya is building a storage cupboard in the shape of a rectangular prism. The rectangular prism has a square base with side lengths of 2.5 feet and a height of 3.5 feet. Compare the amount of paint she would use to paint all but the bottom surface of the prism to the amount she would use to paint the entire prism.

15. **Interpret the Answer** The oatmeal box shown is shaped like a cylinder. Use a net to find the surface area S of the oatmeal box to the nearest tenth. Then find the number of square feet of cardboard needed for 1,500 oatmeal boxes. Round your answer to the nearest whole number.



16. **Analyze Relationships** A prism is made of centimeter cubes. How can you find the surface area of the prism in Figure 1 without using a net or a formula? How does the surface area change in Figures 2, 3, and 4? Explain.

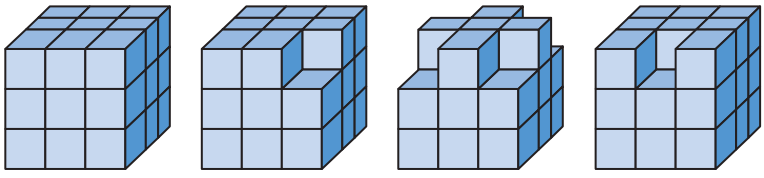


Figure 1 Figure 2 Figure 3 Figure 4

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