



MODULE 12-AREA,SURFACE AREA,AND VOLUME.

LESSON -4-VOLUME OF PRISMS AND PYRAMIDS



What is the plan?

Learning Objective

Students will find the volume of prisms and Pyramids



I'm finished when...

Success Criteria

I can describe the relation between prism and pyramid

I can find the volume of prisms and pyramids

Vocabulary





Prism

Pyramid

Volume

Cubic Units

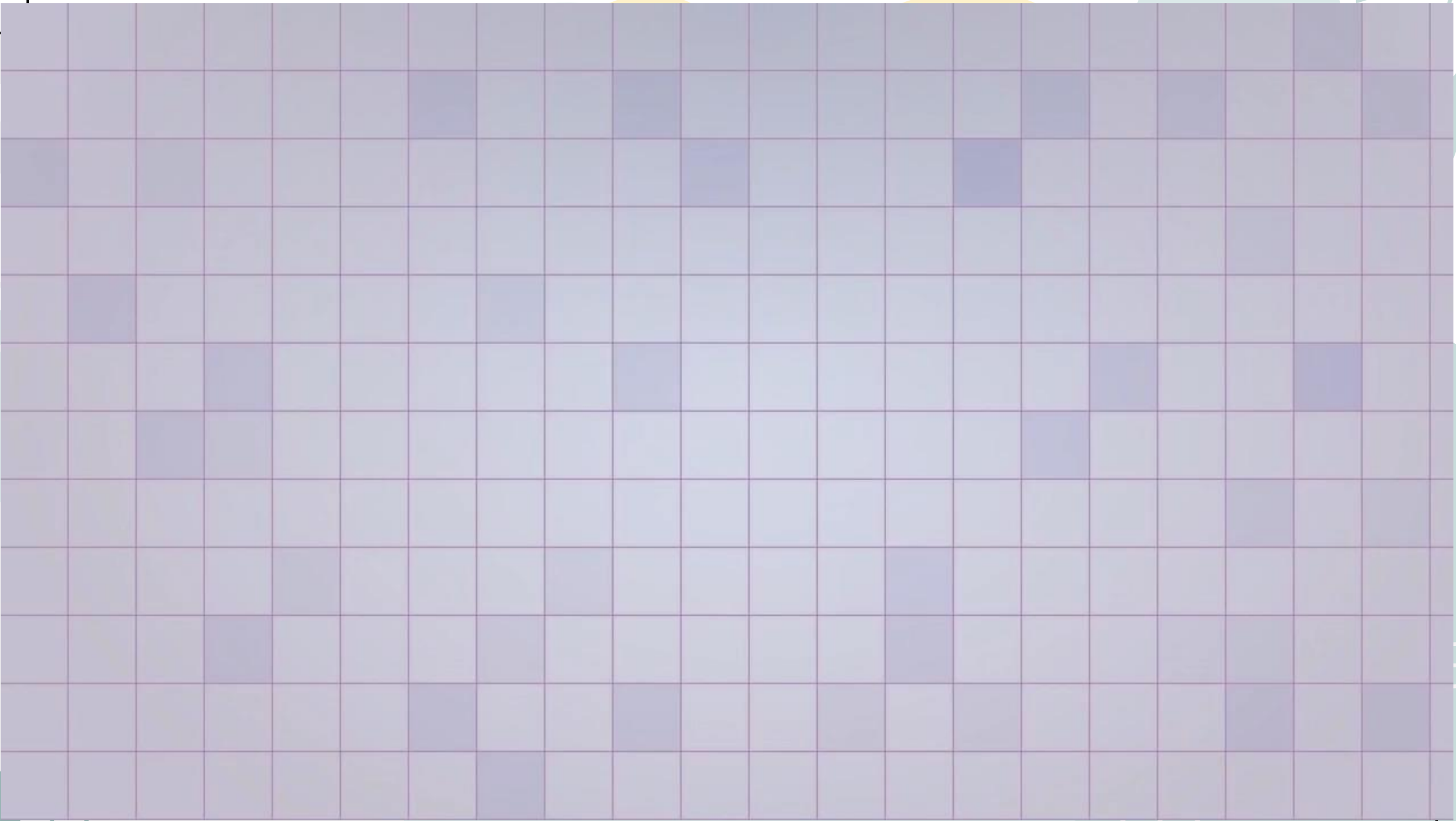
Rectangular Prism

Starter Activity.

Warm Up

Find the area of each figure.

1. triangle with height 177 millimeters and base 78 millimeters
2. triangle with height 3.5 feet and base 1.8 feet
3. rectangle with length 16 inches and width 7 inches
4. parallelogram with height 61 centimeters and base 103 centimeters
5. A triangular frame for a tree house is 4 feet wide and 5.3 feet tall. What is the area of the framed section?



Learn -Volume of Prisms.

The volume of a 3Dimensional figure is the measure of space it occupies. It is measured in cubic units such as cubic centimetres, or cubic inches

A rectangular prism has two parallel congruent bases that are rectangles

A triangular prism has two parallel congruent bases that are triangles

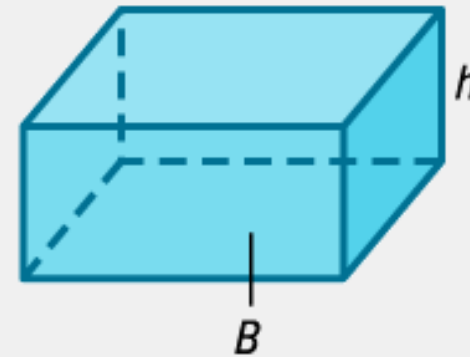
Words

The volume V of a prism is the product of the area of the base B and the height h .

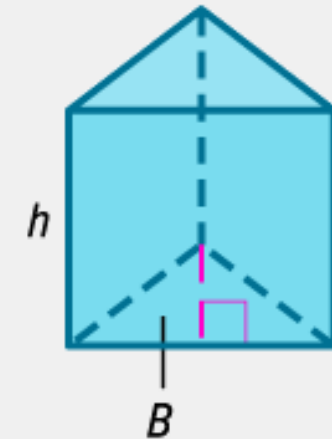
Symbols

$$V = Bh$$

Model



Rectangular
Prism



Triangular
Prism

Example 1 · Volume of Rectangular Prisms

A jewelry box is in the approximate shape of a rectangular prism.

What is the approximate volume of the jewelry box? Round to the nearest tenth if necessary.

Use the formula $V = Bh$ to find the approximate volume of the jewelry box.

$$V = Bh$$

$$V = (\ell w)h$$

$$V \approx (18.4 \cdot 14.8)25.6$$

$$V \approx 6,971.392$$

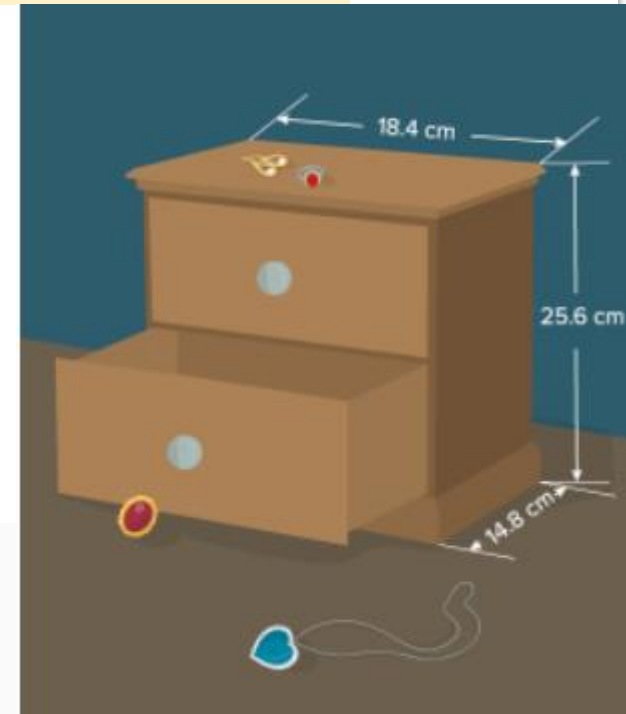
Volume of a prism

The base is a rectangle, so $B = \ell w$.

Replace ℓ with 18.4, w with 14.8, and h with 25.6.

Simplify.

So, the volume of the jewelry box is about cubic centimeters.



Example 2 · Volume of Triangular Prisms

Find the volume of the prism. Round to the nearest hundredth if necessary.

Use the formula $V = Bh$ to find the volume of the prism. The prism is a triangular prism, because the two parallel bases are triangles.

$$V = Bh$$

Volume of a prism

$$V = \left(\frac{1}{2} \cdot 6.5 \cdot 8.25\right)h$$

The base is a triangle, so $B = \frac{1}{2}bh$, where $b = 6.5$ and $h = 8.25$.

$$V = \boxed{} h$$

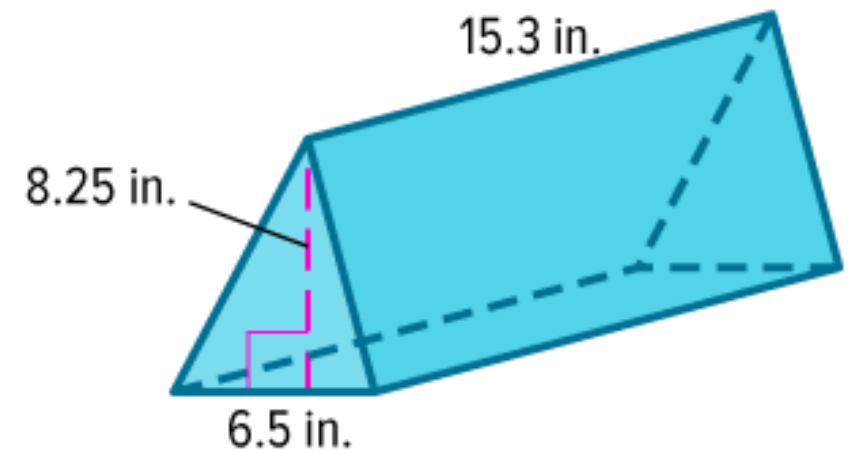
Simplify.

$$V = 26.8125 (\boxed{})$$

Replace h with 15.3.

$$V = 410.23125$$

Simplify.

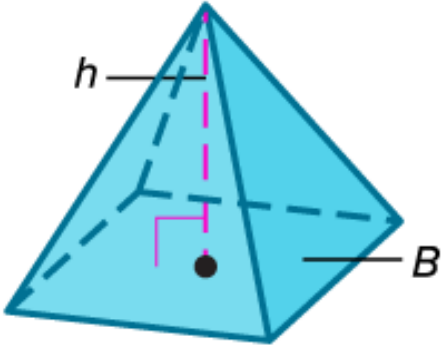


So, the volume of the prism is about $\boxed{}$ cubic inches.

Learn · Volume of Pyramids

A **pyramid** is a polyhedron with one base that is a polygon and three or more triangular faces that meet at a common vertex. In the Explore activity, you learned that a pyramid has one-third the volume of a prism with the same base and height. The height of a pyramid is the perpendicular distance from the vertex of the pyramid to the base.

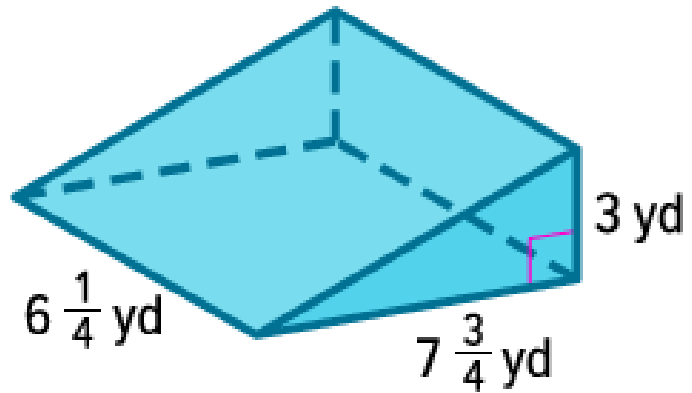
The table shows the use of the formula to find the volume of a pyramid.

Words	Model
The volume V of a pyramid is one third the area of the base B times the height of the pyramid h .	
Symbols	
$V = \frac{1}{3}Bh$	

CHECK · Volume of Triangular Prisms

Find the volume of the prism. Round to the nearest hundredth if necessary.

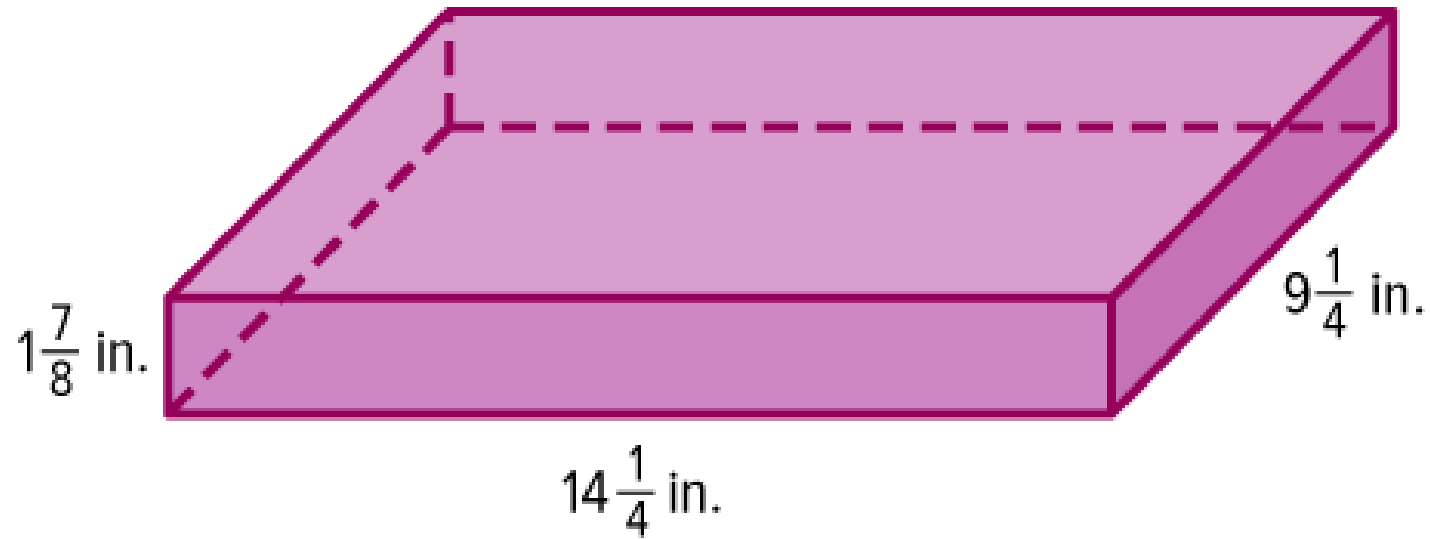
What is the volume of the prism?



Write your answer as a mixed number in simplest form.

CHECK

A gift box has the dimensions shown. What is the volume of the gift box?

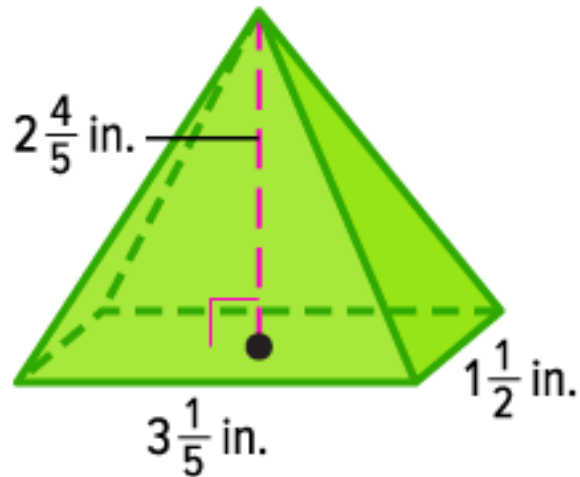


Write your answer as a mixed number in simplest form.

Example 3 · Volume of Pyramids

Find the volume of the rectangular pyramid.

Use the formula $V = \frac{1}{3}Bh$ to find the volume of the pyramid.



$$V = \frac{1}{3}Bh$$

Volume of a pyramid

$$V = \frac{1}{3}(\ell w)h$$

The base is a rectangle, so $B = \ell w$.

$$V = \frac{1}{3} \left(3\frac{1}{5} \cdot 1\frac{1}{2} \right) \left(2\frac{4}{5} \right)$$

Replace ℓ with $3\frac{1}{5}$, w with $1\frac{1}{2}$, and h with $2\frac{4}{5}$.

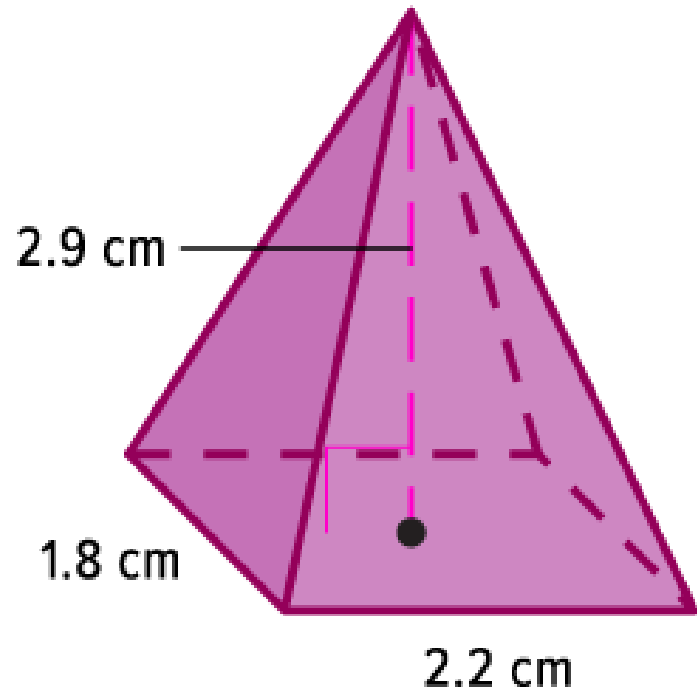
$$V = \boxed{}$$

Simplify.

So, the volume of the pyramid is about $4\frac{12}{25}$ cubic inches.

CHECK · Volume of Pyramids

Find the volume of the pyramid.



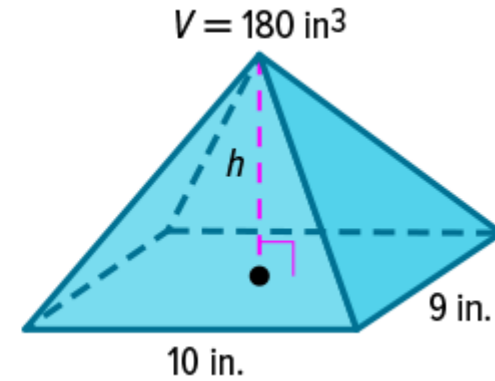
Write your answer as a decimal rounded to the nearest hundredth.

Learn · Use Volume to Find Missing Dimensions

 Go Online

Watch the animation to learn how you can use the volume formula to find missing dimensions if you know the volume.

The animation shows the steps to using the volume formula to find the unknown height for the pyramid shown.



Step 1 Write the volume formula.

$$V = \frac{1}{3}Bh$$

Step 2 Substitute the known values into the formula.

$$180 = \frac{1}{3}(10 \cdot 9)h$$

$$V = 180, B = 10 \cdot 9$$

Step 3 Solve the equation.

$$180 = \frac{1}{3}(10 \cdot 9)h$$

$$180 = \boxed{} h$$

$$\frac{180}{\boxed{}} = \frac{30h}{\boxed{}}$$

$$\boxed{} = h$$

Write the equation.

Multiply.

Divide by 30.

Simplify.



The height of the pyramid is 6 inches.

Example 4 · Use Volume to Find Missing Dimensions

The prism has a volume of 195.075 cubic centimeters.

What is the area of the base of the prism?

The figure is a trapezoidal prism because the shape of the two parallel and congruent bases are trapezoids. You know the volume and height of the prism, and you need to find the area of the base.

Use the formula $V = Bh$ to find the area of the base of the prism.

$$V = Bh$$

Volume of a prism

$$\boxed{} = B (\boxed{})$$

Replace V with 195.075 and h with 7.65.

$$195.075 = 7.65B$$

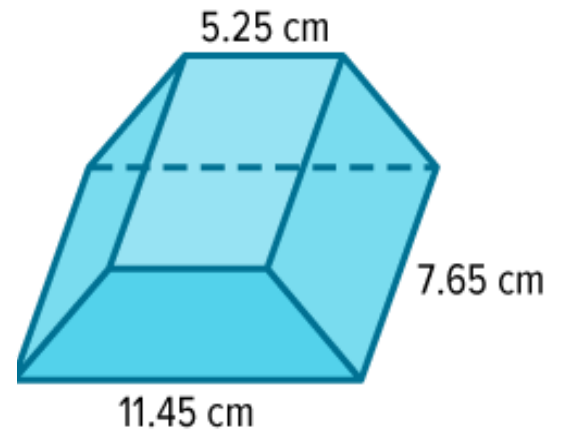
Simplify.

$$\frac{195.075}{7.65} = \frac{7.65B}{7.65}$$

Division Property of Equality

$$25.5 = B$$

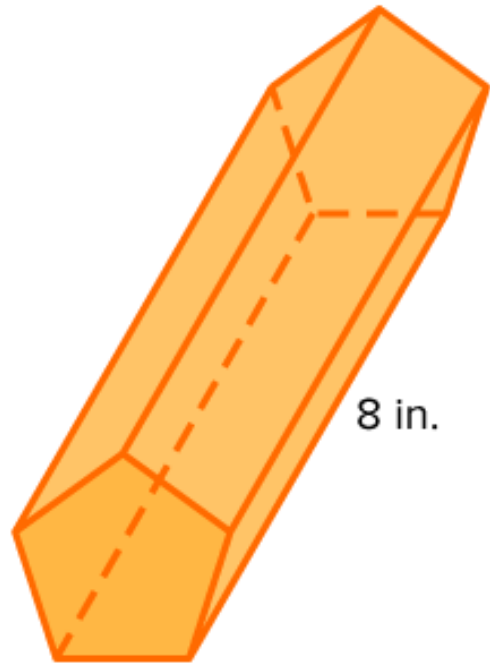
Simplify.



So, the area of the base of the prism is 25.5 square centimeters.

CHECK · Use Volume to Find Missing Dimensions

The pentagonal prism shown has a volume of about $124\frac{4}{5}$ cubic inches. What is the area of the base of the prism?



Example 5 · Use Volume to Find Missing Dimensions

A model of the Great Pyramid of Giza has a square base with sides that are 15 inches long.

If the volume of the model is 675 square inches, what is the height of the model?

You know the volume of the model and the side lengths of the base. Use the formula $V = \frac{1}{3}Bh$ to find the height of the pyramid.

$$V = \frac{1}{3}Bh$$

Volume of a pyramid

$$V = \frac{1}{3}s^2h$$

The base is a square, so $B = s^2$.

$$675 = \frac{1}{3}(15^2)h$$

Replace V with 675 and s with 15.

$$675 = \frac{1}{3}(225)h$$

Simplify.

$$675 = 75h$$

Multiply.

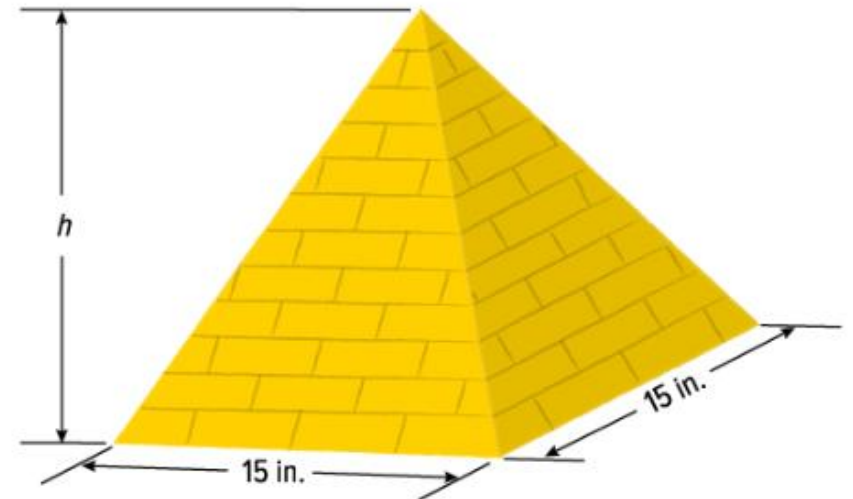
$$\frac{675}{75} = \frac{75h}{75}$$

Division Property of Equality

$$9 = h$$

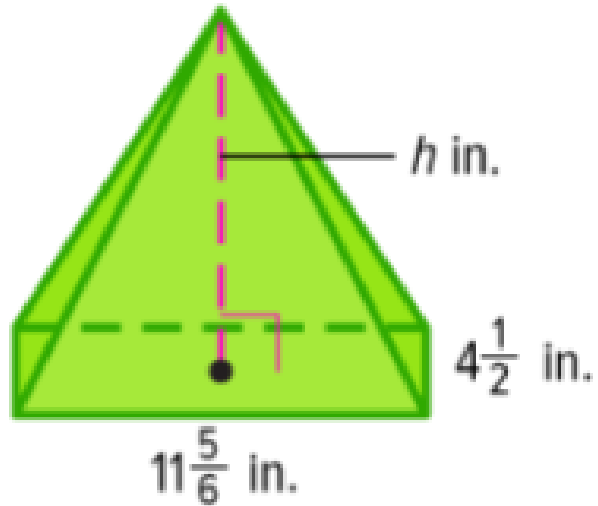
Simplify.

So, the height of the model is 9 inches.



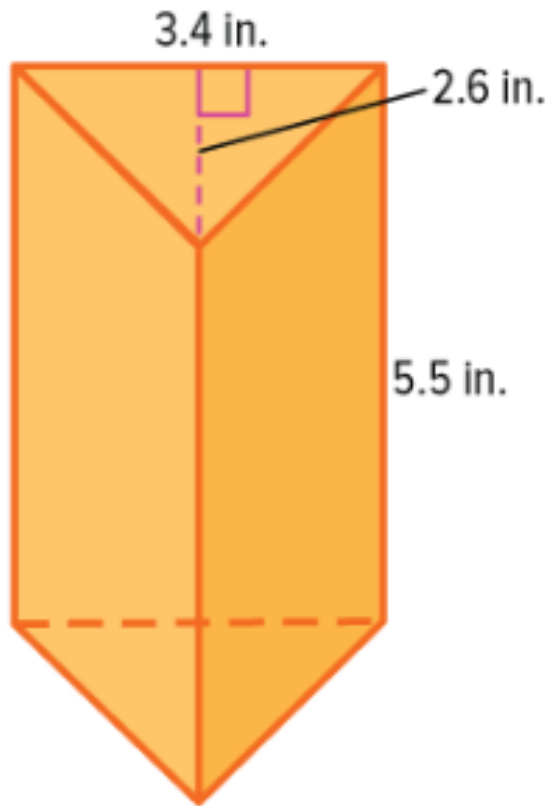
CHECK · Use Volume to Find Missing Dimensions

The pyramid shown has a volume of $266\frac{1}{4}$ cubic inches. What is the height of the pyramid?



So, the height of the model is 9 inches.

Li is mailing a candle that has the dimensions shown in a rectangular box that is 4.2 inches long, 5.8 inches wide, and 7.6 inches tall. If one bag of packing material holds 25 cubic inches of material, how many bags does Li need to buy to fill the space around the candle?



So, the height of the model is 9 inches.

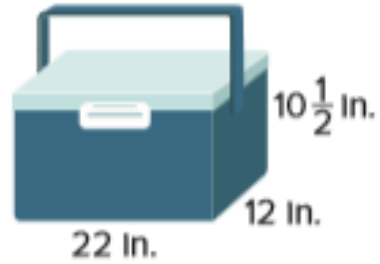
Thema has a raised garden bed in her backyard that is shaped like a rectangular prism. It is 6 feet long, 3 feet wide, and $\frac{2}{3}$ foot deep. If a bag of garden soil holds 960 cubic inches of soil, how many bags will Thema need to fill the bed?



So, the height of the model is 9 inches.

Exercise 1

A cooler is in the shape of a rectangular prism. What is the volume of the cooler? Round to the nearest tenth if necessary



SOLUTION:

$$V = Bh$$

$$V = (\ell w)h$$

$$V = (22 \cdot 12)10\frac{1}{2}$$

$$V = 2,772$$

Volume of a prism

The base is a rectangle, so $B = \ell w$.

Replace ℓ with 22, w with 12, and h with $10\frac{1}{2}$.

Simplify.

So, the volume is 2,772 cubic inches.

Exercise 2

A cereal box is in the shape of a rectangular prism. What is the volume of the cereal box? Express your answer as a decimal rounded to the nearest tenth if necessary.



SOLUTION:

$$V = Bh$$

$$V = (\ell w)h$$

$$V = \left(8 \cdot 1\frac{3}{4}\right)12\frac{1}{8}$$

$$V = 169.8$$

So, the volume 169.8 cubic inches.

Volume of a prism

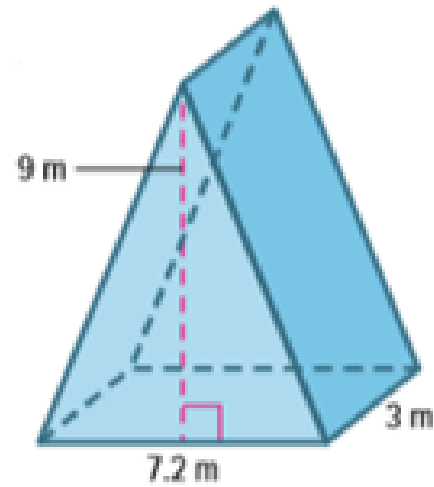
The base is a rectangle, so $B = \ell w$.

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

Simplify.

Exercise 3

Find the volume of the figure. Round to the nearest tenth if necessary.



SOLUTION:

$$V = Bh$$

$$V = \left(\frac{1}{2} \cdot 7.2 \cdot 9\right)h$$

$$V = (32.4)h$$

$$V = (32.4)3$$

$$V = 97.2$$

Volume of a prism

The base is a triangle, so $B = \frac{1}{2}bh$, where $b = 7.2$ and $h = 9$.

Simplify.

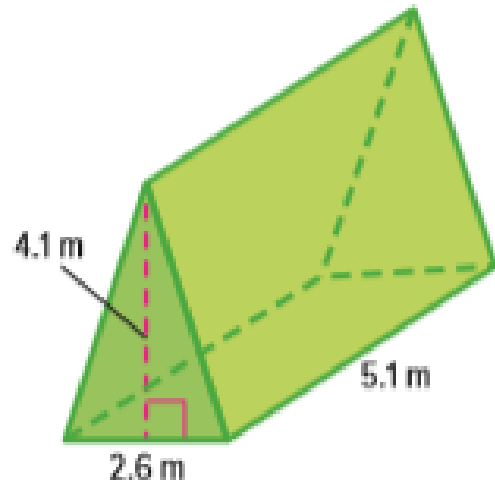
Replace h with 3.

Simplify.

So, the volume 97.2 cubic meters.

Exercise 4

Find the volume of the figure. Round to the nearest tenth if necessary.



SOLUTION:

$$V = Bh$$

$$V = \left(\frac{1}{2} \cdot 2.6 \cdot 4.1\right)h$$

$$V = (5.33)h$$

$$V = (5.33)5.1$$

$$V = 27.2$$

Volume of a prism

The base is a triangle, so $B = \frac{1}{2}bh$, where $b = 2.6$ and $h = 4.1$.

Simplify.

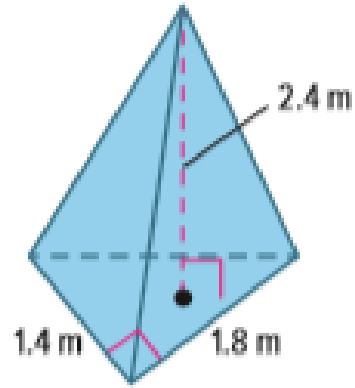
Replace h with 5.1.

Simplify.

So, the volume 27.2 cubic meters.

Exercise 5

Find the volume of the figure. Round to the nearest tenth if necessary.



SOLUTION:

$$V = \frac{1}{3}Bh$$

Volume of a pyramid

$$V = \frac{1}{3}\left(\frac{1}{2} \cdot 1.4 \cdot 1.8\right)h$$

The base is a triangle, so $B = \frac{1}{2}bh$, where $b = 1.4$ and $h = 1.8$.

$$V = \frac{1}{3}(1.26)h$$

Simplify.

$$V = \frac{1}{3}(1.26)2.4$$

Replace h with 2.4.

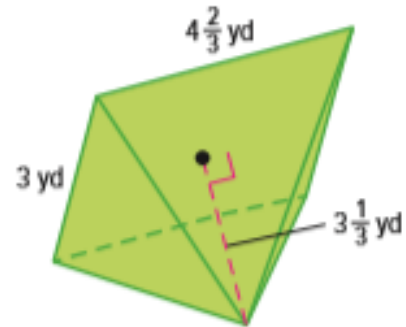
$$V = 1.0$$

Simplify.

So, the volume 1.0 cubic meters.

Exercise 6

Find the volume of the figure. Round to the nearest tenth if necessary.



SOLUTION:

$$V = \frac{1}{3} Bh$$

Volume of a pyramid

$$V = \frac{1}{3} (\ell w) h$$

The base is a rectangle, so $B = \ell w$.

$$V = \frac{1}{3} \left(4\frac{2}{3} \cdot 3 \right) 3\frac{1}{3}$$

Replace ℓ with $4\frac{2}{3}$, w with 3, and h with $3\frac{1}{3}$.

$$V = 15.6$$

Simplify.

So, the volume 15.6 cubic yards.

Exercise 7

A triangular prism has a height of 5.9 meters and volume of 86.376 cubic meters. What is the area of the base of the prism?

SOLUTION:

$$V = Bh$$

$$86.376 = B(5.9)$$

$$86.376 = 5.9B$$

$$\frac{86.376}{5.9} = \frac{5.9B}{5.9}$$

$$14.64 = B$$

Volume of a prism

Replace V with 86.376 and h with 5.9.

Simplify.

Division Property of Equality

Simplify.

So, the area of the base of the prism is 14.64 square meters.

Exercise 8

A rectangular pyramid has a height of 9.5 centimeters and a volume of 494 cubic centimeters. What is the area of the base of the pyramid?

SOLUTION:

$$V = \frac{1}{3}Bh$$

Volume of a pyramid

$$494 = \frac{1}{3}B(9.5)$$

Replace V with 494 and h with 9.5.

$$494 = 3\frac{1}{6}B$$

Simplify.

$$\frac{494}{3\frac{1}{6}} = \frac{3\frac{1}{6}B}{3\frac{1}{6}}$$

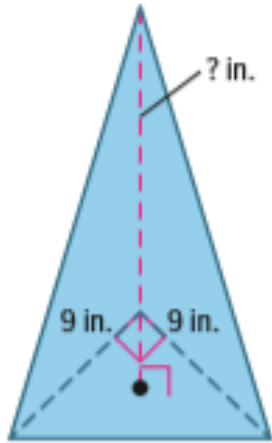
$$156 = B$$

Division Property of Equality

Simplify.

Exercise 9

A glass stand to display a doll is in the shape of a right triangular pyramid as shown. The volume of the stand is 202.5 cubic inches. What is the height of the stand?



SOLUTION:

$$V = \frac{1}{3}Bh$$

Volume of a pyramid

$$V = \frac{1}{3}\left(\frac{1}{2} \cdot 9 \cdot 9\right)h$$

The base is a triangle, so $B = \frac{1}{2}bh$ where $b = 9$ and $h = 9$.

$$V = \frac{1}{3}(40.5)h$$

Simplify.

$$202.5 = \frac{1}{3}(40.5)h$$

Replace V with 202.5.

$$\frac{202.5}{13.5} = \frac{13.5h}{13.5}$$

Multiply.

Division Property of Equality

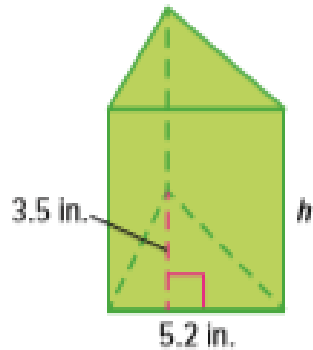
$$15 = h$$

Simplify.

The height of the stand is 15 inches.

Exercise 10

Open Response A triangular box of sticky notes is shown. The volume of the box of sticky notes is 54.6 cubic inches. What is the height of the box of sticky notes?



SOLUTION:

$$V = Bh$$

$$V = \left(\frac{1}{2} \cdot 5.2 \cdot 3.5\right)h$$

$$V = (9.1)h$$

$$54.6 = (9.1)h$$

$$\frac{54.6}{9.1} = \frac{9.1h}{9.1}$$

$$6 = h$$

Volume of a prism

The base is a triangle, so $B = \frac{1}{2}bh$ where $b = 5.2$ and $h = 3.5$.

Simplify.

Replace V with 54.6.

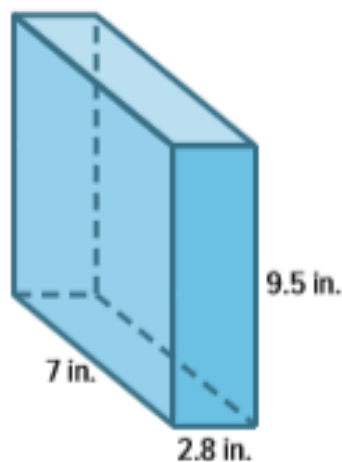
Division Property of Equality

Simplify.

The height of the box of sticky notes is 6 inches.

Exercise 11

Sasha is mailing a photo box that has the dimensions shown in a rectangular box that is 12.5 inches long, 4.2 inches wide, and 12.5 inches tall. If one bag of packing material holds 75 cubic inches of material, how many bags does Sasha need to buy to fill the space around the photo box?



SOLUTION:

Find the volume of the photo box and the rectangular box.

Photo Box

$$V = Bh$$

Volume of a prism

$$V = (\ell w)h$$

$$B = \ell w$$

$$V = (7 \cdot 2.8)9.5$$

Replace variables.

$$V = 186.2$$

Simplify.

So, the volume is 186.2 cubic inches.

Rectangular Box

$$V = Bh$$

Volume of a prism

$$V = (\ell w)h$$

$$B = \ell w$$

$$V = (12.5 \cdot 4.2)12.5$$

Replace variables.

$$V = 656.25$$

Simplify.

So, the volume is 656.25 cubic inches.

Subtract the volumes to find the space around the photo box.

$$656.25 - 186.2 = 470.05$$

The space around the photo box is 470.05 cubic inches.

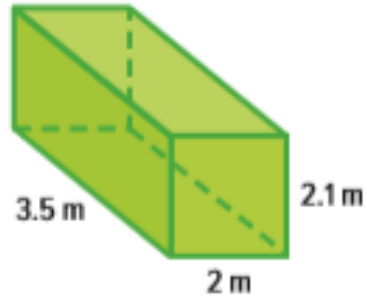
Divide the volume by the amount of packing material in 1 bag.

$$470.05 \div 75 = 6.25\dots$$

Because she needs more than 6 bags round 6.25 to 7. She will need 7 bags.

Exercise 12

The cargo bed of a commercial truck is a rectangular prism. The dimensions are shown. He has 80 cubic meters of mulch to take to his house. How many trips will Billy have to make until all the mulch is at his house?



SOLUTION:

Find the volume of the truck.

$$V = Bh \quad \text{Volume of a prism}$$

$$V = (\ell w)h \quad \text{The base is a rectangle, so } B = \ell w.$$

$$V = (3.5 \cdot 2)2.1 \quad \text{Replace } \ell \text{ with } 3.5, w \text{ with } 2, \text{ and } h \text{ with } 2.1.$$

$$V = 14.7 \quad \text{Simplify.}$$

So, the volume of the cargo bed is 14.7 cubic inches.

Divide the volume of the mulch by the volume of the cargo bed.

$$80 \div 14.7 = 5.44\dots$$

Because he has some mulch remaining after 5 trips round 5.44... to 6. He will make 6 trips.

Exercise 13

Create Write and solve a real-world problem that involves finding the volume of a rectangular prism or triangular prism.

SOLUTION:

Sample answer: Alexia's bathroom has a tub in the shape of a rectangular prism with a length of 1.5 meters, a width of 0.8 meter, and a height of 0.4 meter. How many cubic meters of water can it hold?;

Find the volume of the prism.

$$\begin{aligned} V &= (1.5 \cdot 0.8)0.4 \\ &= 0.48 \text{ m}^3 \end{aligned}$$

Exercise 14

Reason Abstractly Determine if the statement is *true* or *false*. Write an argument to justify your solution.

If a square pyramid and a cube have the same bases and volumes, then the height of the cube is three times the height of the pyramid.

SOLUTION:

false; Sample answer: The height of the pyramid is three times the height of the cube. For example, the base area of a cube is 9 in^2 and the volume is 27 in^3 . So, the height is 3 in. The base area of a square pyramid is 9 in^2 and the volume is 27 in^3 . So, the height must be 9 in.

Exercise 15

A rectangular prism has a volume of 96 cubic inches. Find two possible measurements for the base area and height of the prism

SOLUTION:

Sample answer:

First prism: area of the base: 24 in^2 and height: 4 in.

$$\begin{aligned} V &= 24(4) \\ &= 96 \text{ in}^3 \end{aligned}$$

Second prism: area of the base: 16 in^2 and height: 6 in.

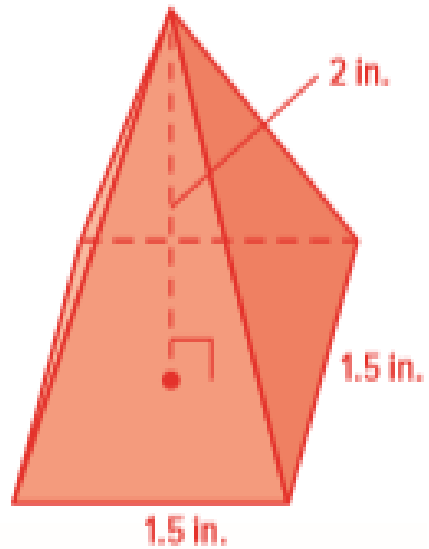
$$\begin{aligned} V &= 16(6) \\ &= 96 \text{ in}^3 \end{aligned}$$

Exercise 16

Draw and label a real-world object that is in the shape of a square pyramid or triangular pyramid. Then find the volume of the object.

SOLUTION:

Sample answer: a small stone; $V = \frac{1}{3} (1.5 \cdot 1.5) 2$ or 1.5 in^3



Thank you!