# VOLUME AND SURFACE AREA OF SOLIDS

When working with 3-D shapes we can find the volume of the shapes. The volume is the capacity that the shape can hold. It is measured in cubic units. We can also find the surface area of the shape. The surface area is the total area of all the faces on the shape. Surface area is measure in square units.

To compute the volume of a rectangular prism, find the area of the base (length times width), and then multiply by the height to find the capacity of the prism in cubic units.

To compute the surface area of a rectangular prism, find the area of each of the faces, and then add them together to find the total number of square units.

To compute the volume of a cylinder, find the area of the circular base, and then multiply by the height to find the capacity of the cylinder in cubic units.

To compute the surface area of a cylinder, find the area of the two circular bases, and the area of the curved rectangular body, and then add them together to find the total number of square units.

# Volume of a Rectangular Prism

The volume of a rectangular prism is the amount of space within, it's capacity. Volume is the amount a container will hold measured in cubic units.
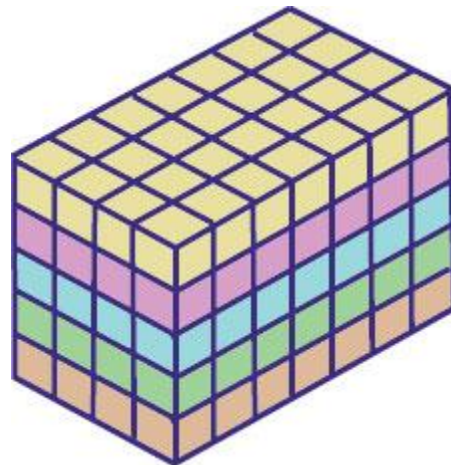
5 ft

4 ft

7 ft
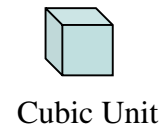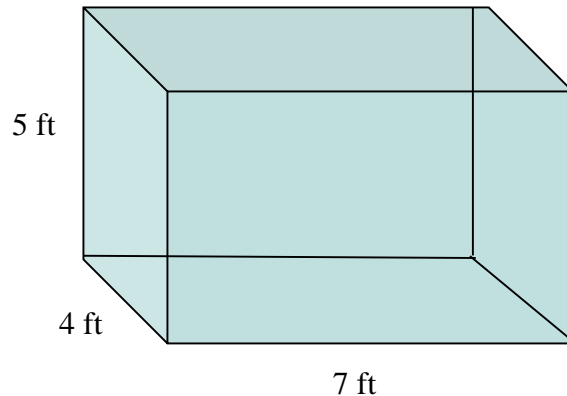
Cubic Unit

**Compute the volume of the rectangular prism.**

$$V = l \times w \times h$$

$$V = 7 \text{ ft} \times 4 \text{ ft} \times 5 \text{ ft}$$

Volume = 140 cubic feet

Here is another view of the rectangular prism, divided into cubic units. To figure the total number of cubic units within the prism, you would multiply the length of 7 by the width of 4 and get 28, and then multiply by the height of 5 to get 140 cubic units.

# Surface Area of a Rectangular Prism

**The surface area of a rectangular prism is the total area of all of the rectangular faces measured in square units.**

Square Unit

5

4

7

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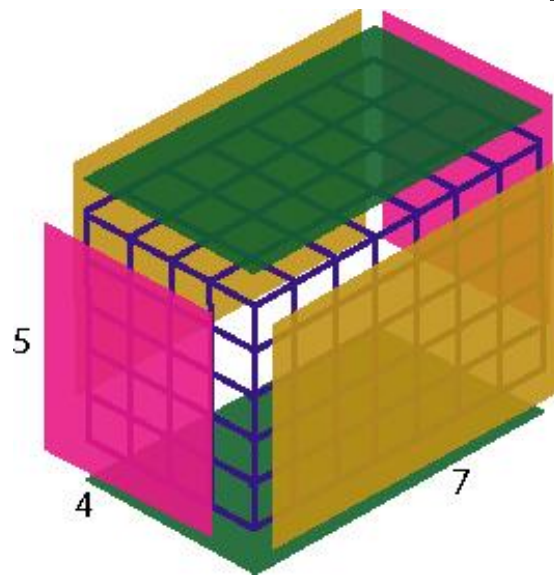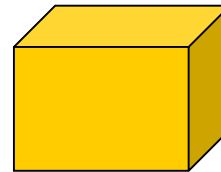
**Compute the surface area of the rectangular prism**

| Face | Dimensions | Computation | Area |
|---|---|---|---|
| Front | 7ft across by 5ft tall | 7 x 5 | 35 square ft |
| Back (hidden from view, same as front) | 7ft across by 5ft tall | 7 x 5 | 35 square ft |
| Bottom (Side the box is sitting on) | 7ft across by 4ft wide | 7 x 4 | 28 square ft |
| Top (Same dimensions as the bottom) | 7ft across by 4ft wide | 7 x 4 | 28 square ft |
| Left Side | 5ft wide by 4ft tall | 5 x 4 | 20 square ft |
| Right Side (hidden from view, same as left) | 5ft wide by 4ft tall | 5 x 4 | 20 square ft |

**Total Surface Area** (Add all the areas of the 6 faces) ------------------------------->166square ft

# Volume of Cylinders
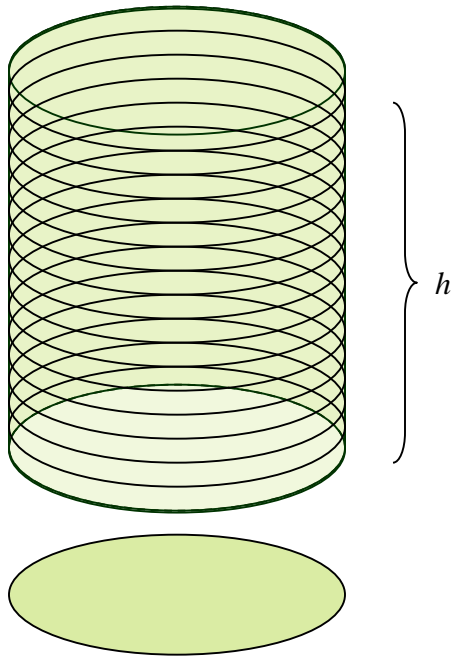
The **volume of a cylinder** is the amount a cylinder can hold measured in cubic units. To calculate the volume of a cylinder, multiply the area of its base times its height.

$$V = \text{Area of Base} \times \text{Height}$$
$$V = \pi \times r^2 \times h$$

*The base of a cylinder is a circle.*

$h$

Area of Base

*Example*: Find the volume of a cylinder that has a radius of 5 inches and a height of 9 inches.
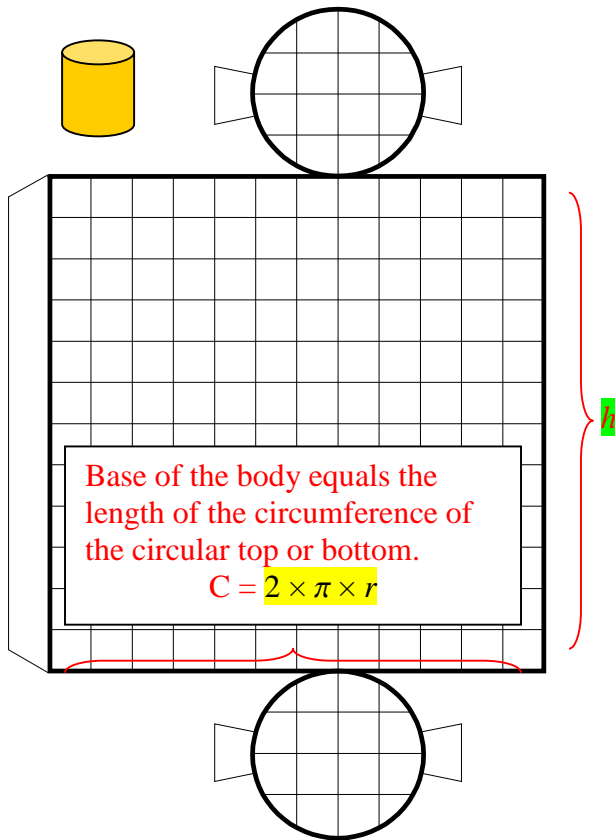
$$V = \pi \times r^2 \times h$$
$$V = 3.14 \times 5^2 \, x \, 9$$
$$V = 3.14 \times 25 \times 9$$
$$V = 706.5 \text{ cubic inches}$$

*Reminder: Volume is measured in cubit units.*

# Surface Area of a Cylinder

To calculate the surface area of a cylinder, calculate the area of the three parts of the cylinder: the top, the bottom, and the body.

**Top: Circle**
$A = \pi \times r^2$

**Bottom: Circle**
$A = \pi \times r^2$

**Body**
$A = \quad b \quad \times \quad h$
$A = 2 \times \pi\, r \times \quad h$

**Total Surface Area**

**SA = Top + Bottom + Body**

Base of the body equals the length of the circumference of the circular top or bottom.
$C = 2 \times \pi \times r$

$h$

Find the surface area of a cylinder whose radius is 2 inches and its height is 4 inches.

**Top: Circle**
$A = \pi \times r^2$
$A = 3.14 \times 2^2$
$A = 12.56$ square inches
**Bottom: Circle**
$A = \pi \times r^2$
$A = 3.14 \times 2^2$
$A = 12.56$ square inches
**Body**
$A = 2 \times \pi\, r \times \quad h$
$A = 2 \times 3.14 \times 2 \times 3$
$A = 37.68$ square inches

**Total Surface Area**　　　**SA = Top + Bottom + Body**
SA = 12.56 + 12.56 + 37.68
SA = 62.8 square inches