



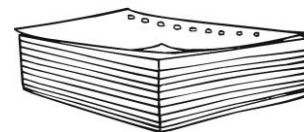
Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Student Exploration: Prisms and Cylinders

**Vocabulary:** cylinder, height (of a cylinder or prism), prism, volume

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)



1. Kyle stacks 30 sheets of paper as shown to the right. Each sheet weighs about 5 g. How can you find the weight of the whole stack?

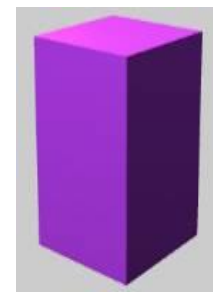
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2. The stack of paper accidently gets nudged and tilted a little to the side. Does this change the weight of the stack? \_\_\_\_\_ Explain. \_\_\_\_\_

\_\_\_\_\_

### Gizmo Warm-up

A **prism** is a closed, three-dimensional figure like the one shown to the right. Prisms are made of flat, polygonal surfaces called faces. Two parallel faces are called bases. A **cylinder** (like a can) is also a closed, three-dimensional figure, but its bases are circles, and it has a curved lateral surface.



In the *Prisms and Cylinders* Gizmo, you can explore the **volume** (cubic units inside) of a dynamic prism or cylinder. To resize a figure, either drag the sliders, or click on the number in the text field next to a slider, type a new value, and hit **Enter**.

1. In the Gizmo, be sure **Rectangle** (under **Shape of base**) and **Drag to rotate** are selected. The figure has rectangular bases, like the one above, so it's called a rectangular prism.

- A. Drag the **Height** slider back and forth. How does the prism change? \_\_\_\_\_

\_\_\_\_\_

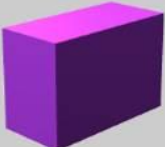
- B. The **height** of the prism is actually a distance. What distance is it? (Fill in the blank.)

The height of a prism is the perpendicular distance between the two \_\_\_\_\_

2. Drag the **Base length** and **Base width** sliders. How does the prism change? \_\_\_\_\_

\_\_\_\_\_



|   |  |   |
|---|--|---|
| <b>Activity A:<br/>Volume of prisms</b> | <u>Get the Gizmo ready:</u>  |  |
|   | <ul style="list-style-type: none"> <li>• Be sure <b>Rectangle</b> is selected from the <b>Shape of base</b> dropdown menu.</li> <li>• Be sure <b>Drag to rotate</b> is turned on.</li> </ul> |   |

1. In the Gizmo, set the **Height** of the prism to 1 unit, the **Base length** to 9 units, and the **Base width** to 6 units.

A. Find the area of the base. Show your work. \_\_\_\_\_

Turn on **Show area of base** to check your answer.

B. Select **Show volume**. What is the volume of this prism? \_\_\_\_\_

C. Explain why the units used for area of the base and volume of the prism are different.

\_\_\_\_\_

\_\_\_\_\_

D. Fill in the first row of the table below for the prism above. Then, create 4 more rectangular prisms of your choice, and fill in the rest of the table (including the units).

| Height ( <i>h</i> ) | Base length ( <i>l</i> ) | Base width ( <i>w</i> ) | Base area ( <i>B</i> ) | Volume ( <i>V</i> ) |
|---------------------|--------------------------|-------------------------|------------------------|---------------------|
| 1 unit              | 9 unit                   | 6 unit                  |                        |                     |
|                     |                          |                         |                        |                     |
|                     |                          |                         |                        |                     |
|                     |                          |                         |                        |                     |
|                     |                          |                         |                        |                     |

E. Study the table above to try to figure out how the volumes were calculated. Then, below, write two different formulas for finding the volume (*V*) of a rectangular prism. In the first, use base area (*B*). In the second, use length (*l*) and width (*w*).

$$V = \underline{\hspace{2cm}} \qquad V = \underline{\hspace{2cm}}$$

F. Explain why both of the formulas you wrote above will work. Then, experiment with a variety of rectangular prisms to check the formulas.

\_\_\_\_\_

\_\_\_\_\_

**(Activity A continued on next page)**



**Activity A (continued from previous page)**

2. Turn off **Show volume** and **Show area of base**. Set **Height**, **Base length**, and **Base width** to all be equal to each other.

A. This is a special type of prism called a cube. Sketch your cube in space to right. Label all dimensions (height, base length, and base width).

B. Find the volume of your cube. Show your work. Then select **Show volume** to check.

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C. Experiment with a variety of cubes in the Gizmo and find their volumes. Suppose  $s$  is the length of the edge of each cube. Use  $s$  to write a formula for the volume of a cube.  $V =$  \_\_\_\_\_

3. Turn off **Show volume** and **Show area of base**. Set **Height** to 4 units, **Base length** to 5 units, and **Base width** to 7 units.

A. Find the volume of this prism. \_\_\_\_\_

Then check your answer in the Gizmo.

B. Select **Drag to skew**. Drag the prism to tilt it to one side. A tilted prism is called an oblique prism (as opposed to a right prism, which is not tilted). How does the volume of this oblique prism compare to that of the right prism with the same dimensions?

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Experiment with other prisms to see if this is always true.

C. How is an oblique prism similar to a tilted stack of papers? \_\_\_\_\_

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4. Turn off **Show volume**. Select **Triangle** from the **Shape of base** dropdown menu. Turn on **Drag to rotate** and **Show area of base**. Set **Height** to 3 units and **Base edge** to 7 units.

A. What is the area of the base of this triangular prism? \_\_\_\_\_


B. What do you think the volume of this prism is? \_\_\_\_\_

Explain why. \_\_\_\_\_

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Explore other triangular prisms to verify that  $V = Bh$  always works for them too.



|  |  |   |
|--|--|---|
| <b>Activity B:</b><br><b>Volume of cylinders</b> | <u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Be sure <b>Drag to rotate</b> is selected.</li> </ul> |  |
|--|--|---|

- In the Gizmo, select **Circle** under **Shape of base** to make a cylinder. Set the cylinder's **Height** to 1 unit and the **Radius** to 5 units.
  - Find the exact area of the base. (Write the area with a  $\pi$  in it, not as a long decimal.)  
 \_\_\_\_\_ Turn on **Show area of base** to check.
  - Select **Show volume**. What is the volume of the cylinder? \_\_\_\_\_
  - Fill in the first row of the table below. Then, in the Gizmo, create 4 more cylinders of your choice, and record your results (with units). Express area and volume using  $\pi$ .


| Height ( $h$ ) | Radius ( $r$ ) | Base area ( $B$ ) | Volume ( $V$ ) |
|----------------|----------------|-------------------|----------------|
| 1 unit         | 5 units        |                   |                |
|                |                |                   |                |
|                |                |                   |                |
|                |                |                   |                |
|                |                |                   |                |

- With the help of the table above, write two different formulas for finding the volume ( $V$ ) of a cylinder. In the first, use base area ( $B$ ). In the second, use radius ( $r$ ).  
 $V =$  \_\_\_\_\_       $V =$  \_\_\_\_\_
- Experiment with a variety of cylinders to verify your formulas. Then explain why they both work.  
 \_\_\_\_\_  
 \_\_\_\_\_

- Set **Height** to 8 units and **Radius** to 6 units. The cylinder you created is a right cylinder (straight up and down). Select **Drag to skew**. Drag an edge of the cylinder to tilt it to one side and make it oblique. How do the volumes of the oblique and right cylinders compare?  
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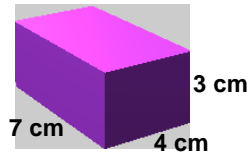
Experiment with other cylinders to see if this is always true.



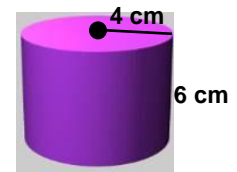
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| <p><b>Activity C:</b><br/><b>Using volume</b></p> | <p><u>Get the Gizmo ready:</u></p> <ul style="list-style-type: none"> <li>• Be sure <b>Drag to rotate</b> is selected.</li> </ul> |  |
|---|---|---|

Solve each problem. Show all of your work. Then, if possible, check your answers in the Gizmo.

1. Find the volume of the prism.



4. Find the volume of the cylinder in terms of  $\pi$ .



2. An oblique triangular prism has a height of 5 in. and a base area of  $10.4 \text{ in.}^2$ . Find the volume of this prism.

5. An oblique cylinder has a diameter of 7 ft and a height of 4 ft. What is the volume of this cylinder in terms of  $\pi$ ?

3. The base of a rectangular prism is 4 m long and 3 m wide. If the prism has a volume of  $72 \text{ m}^3$ , what is its height?

6. Find the radius of a cylinder with a height of 8 m and a volume of  $128\pi \text{ m}^3$ .