### **ME8-9 Right Prisms**





a)





**5.** Now sketch two different rectangular prisms. Make the hidden edges dashed, and make sure none of your edges overlap!

b)

#### How to sketch a right prism standing on its base

**Step 1:** Sketch two congruent polygons, one directly above the other.



corresponding vertices.

Step 2: Join the

**Step 3:** Use an eraser to make the hidden edges dashed.



- 6. Follow the steps above to sketch three prisms with bases of different shapes.
- **7.** Match each set of dimensions to the sketch that fits best. Then mark the length, height, and width of each prism on the sketch.



# ME8-10 Nets of Right Prisms

**1.** The polygons below are faces of a prism. Mark the equal sides on all the faces. Name the prism you could make if you assembled the faces.



2. Shade the bases of each shape and then complete the chart.

Number of sides on base		
Number of (non-base) rectangular faces		

What relationship do you see between the number of sides on the base of a prism and the number of (non-base) rectangular faces?

3. Draw a net for the box on the grid and label each face.



**4.** How many copies of each face do you need to make the prism? Mark the dimensions on each face.



5. Circle the sketch or sketches that could be the net for the prism.



- c) Explain what is wrong with the sketches you did not circle.
- 6. Mark the edges that will be glued together with the same number.



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**7.** Circle the shape that could be the missing face for the net. Then add this face to the net.



8. Sketch a net for the prism. Name the prism.







**9.** Match each net to a 3-D shape.



**BONUS** ► Match the 3-D shapes to the nets.



## **ME8-11 Volume of Rectangular Prisms**





**INVESTIGATION** ► In a rectangular prism made of blocks, how is the area of the base related to the volume?

These prisms are made from 1 cm<sup>3</sup> blocks:

i)		ii)	iii)	iv)				
Α.	The base is shaded. When	hat is the area of the base	in each prism?					
	i) <u>12 cm<sup>2</sup></u>	ii)	iii)	iv)				
В.	What is the volume of o	ne horizontal layer of bloc	cks in each prism?					
	i) <u>12 cm<sup>3</sup></u>	ii)	iii)	iv)				
C.	How are the answers in	A and B related? Are the	numbers the same? The	units?				
D.	How many horizontal la	yers are in each prism?						
	i)	ii)	iii)	iv)				
Е.	What is the height of ea	ich prism?						
	i)	ii)	iii)	iv)				
F.	How are the answers in	D and E related? Are the	numbers the same? The	units?				
G.	The volume of a prism = (volume of one horizontal layer) $\times$ (number of horizontal layers). Find the volume of each prism.							
	i)	ii)	iii)	iv)				
Н.	What can you multiply b	by the area of the base to	get the volume of a prism	?				
_	V = (area of base) $\times$							
4.	The base of a rectangul layer is cm³.	lar prism has area 15 cm²	. The volume of one horiz	ontal				
	The height of the prism is 4 cm. How many 1 cm layers are there?							
	The volume of the prism	n is cm³ ×	= cm³.					
5.	Find the volume of the r	ectangular prism at right i	n two ways.					
	Volume of one layer $\times$ number of layers = cm <sup>3</sup> $\times$ = cm <sup>3</sup>							
	Area of base $\times$ height =	= cm² × cn	n = cm <sup>3</sup>					

The volume of a rectangular prism = area of base  $\times$  height.

- 6. Look at the prism at right.
  - a) What is the area of the left side? \_\_\_\_\_ cm<sup>2</sup>

What is the volume of the leftmost layer? \_\_\_\_\_ cm<sup>3</sup>

Compare your answers. Are the numbers the same? Are the units the same? Explain.

b) How many vertical layers are there?

What is the length of the prism? \_\_\_\_\_ cm



c) The volume of a right rectangular prism made of centimetre cubes is (number of layers in prism)  $\times$  (number of cubes in each layer).

Explain why this formula gives the same answer as (length of prism)  $\times$  (area of left face of prism).

7. What do you multiply each area by to find the volume of a rectangular prism — length, width, or height?



- a) area of top  $\times$  \_\_\_\_\_
- b) area of right side  $\times$  \_\_\_\_\_
- c) area of bottom × \_\_\_\_\_
- d) area of back × \_\_\_\_\_
- e) area of left side  $\times$  \_\_\_\_\_
- f) area of front  $\times$  \_\_\_\_\_

**8.** Find the volume of the prism in three different ways.





c) area of right side  $\times$  \_\_\_\_\_

 $= \underline{\qquad} \operatorname{cm}^2 \times \underline{\qquad} \operatorname{cm} = \underline{\qquad} \operatorname{cm}^3$ 

Did you get the same answer all three ways?

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Measurement 8-11



- **10.** Mentally rotate the prisms in Question 9 so that the shaded base is on the bottom. Sketch the results.
  - a) b) c) d)
  - e) Calculate the volume of each prism using this formula: volume = area of bottom face  $\times$  height.

Do you get the same answer? Why is this the case?

**11.** a) Find the volume of the rectangular prism. All lengths are in centimetres.



b) What do you notice about the volumes of the three prisms in part a)? Why is this the case?

**12.** Without calculating the volumes, decide which two prisms have the same volume. How did you decide?



Measurement 8-11

## **ME8-12 Volume of Polygonal Prisms**

**INVESTIGATION 1**  $\blacktriangleright$  Does the volume of any prism made from centimetre cubes = area of base  $\times$  height?







A. Complete the chart for each prism shown.

Figure	i)	ii)	iii)
Volume of one layer (cm <sup>3</sup> )	11		
Number of layers	2		
Volume of structure (cm <sup>3</sup> )	22		
Area of base (cm <sup>2</sup> )	11		
Height of structure (cm)	2		

**B.** Is the volume of any prism made from blocks equal to (area of base)  $\times$  (height)?

**INVESTIGATION 2** ► Does the volume of a triangular prism = area of base × height?

- **A.** What fraction of the rectangle is the triangle? Explain.
  - a)
- U





**B.** What fraction of the rectangular prism is the triangular prism? Explain.







- **C.** How can you use the volume of the rectangular prisms to find the volume of the triangular prisms?
  - volume of triangular prism = (volume of rectangular prism)  $\div$
- **D.** The volume of the rectangular prism at right is

(area of rectangle)  $\times$  (\_\_\_\_\_\_ of prism)

= 2 × (area of \_\_\_\_\_\_) × (\_\_\_\_\_\_ of prism) So the volume of a triangular prism is

(area of \_\_\_\_\_) × (\_\_\_\_\_\_ of prism)



Measurement 8-12

**1.** Imagine rotating the prism so that the shaded base is on the bottom. Trace an edge that shows the height.







20 cm

15 cm

15 cm<sup>2</sup>

20 cm<sup>2</sup>

- **2.** The bases of the prism are shaded.
  - a) Label the height *h* along one of the edges.
  - b) Explain why the volume of the prism is  $15 \times h + 20 \times h$ .

5 cm

- c) Is the expression  $15 \times h + 20 \times h$  equal to the expression  $(15 + 20) \times h$ ? Check for h = 1, h = 2, and h = 3.
- d) How do your answers to parts b) and c) show that the volume of the prism is equal to **area of base**  $\times$  **height**?
- **3.** Decompose the base into triangles and rectangles. Then find the area of the base and the volume of the prism. 4 cm





b)



**4.** Estimate, then calculate, the volume of a prism with height 10 cm and the base shown.



- 5. Sketch and label two prisms with different heights that have volume 300 cm<sup>3</sup>.
- 6. The volume of a right triangular prism is 600 cm<sup>3</sup>. Its height is 15 cm. What is the area of the base of this prism? Explain how you found your answer.

# ME8-13 Volume of Cylinders

1. Calculate the volume of the prism.



A cylinder is like a prism, but with circles for bases.

#### **INVESTIGATION** ► What is the formula for the volume of a cylinder?

A. Predict the formula for the volume of a cylinder in terms of its base and height. Explain your prediction.

B. The volume of a can of food is given on the label. Bilal estimates the inside radius



and inside heig	ht of four cans	, and creates tl	nis table.			base
Can	Inside Radius ( <i>r</i> )	r <sup>2</sup>	Inside Height ( <i>h</i> )	$h  imes r^2$	Volume of Food ( <i>V</i> )	$\frac{V}{hr}$

Can	( <i>r</i> )	r-	( <i>h</i> )	$h \times r^2$	Food ( <i>V</i> )	$\overline{hr^2}$
pea soup	4.8 cm		11 cm		796 cm <sup>3</sup>	
pasta sauce	4.1 cm		13 cm		680 cm <sup>3</sup>	
mixed beans	4 cm		10.8 cm		540 cm <sup>3</sup>	
tomato paste	2.5 cm		8 cm		156 cm <sup>3</sup>	

Bilal measured the outside height of the pea soup can to be 11.8 cm. Why did he estimate a smaller number for the inside height?

Bilal measured the outside diameter of the pea soup can to be 10 cm. What is the outside radius? \_\_\_\_\_ Why did he estimate 4.8 cm for the inside radius? \_\_\_\_\_

- C. Complete Bilal's table.
- **D.** Which column has values always close to  $\pi \approx 3.14$ ?
- **E.** Use your answer in part D to write a formula for the volume of a can.

 $\pi pprox V \div$  ( ) so the formula is:  $V = \pi \times$ 

- **F.** The base of a cylinder is a circle with radius *r*. The area of the circle is
- **G.** Use your answer in F to rewrite your formula from E for the volume of a cylinder:

V = (area of base circle)  $\times$ 

- **H.** How is the formula for the volume of a cylinder like the formula for the volume of a prism? Why does this make sense? Hint: Think about how cylinders are like prisms.
- Was your prediction in part A correct? Ι.

**2.** The volume of a cylinder is equal to (area of base)  $\times$  height. Find the volume (*V*) of the cylinder.



**3.** Use the radius or diameter to find the area of the base and the volume of the cylinder.



**4.** Tina has a jar 20 cm high. She can fit 30 candies flat on the bottom of the jar. Each candy is 1 cm high. How many candies can she fit into the jar if...

a) the jar is a cylinder? b) the jar is a right prism?

Are the two answers the same? Why does this happen?

- **5.** Regular polygons with many sides look a lot like circles. Some Canadian pennies are circular, but some are polygonal.
  - a) Estimate the volume of a penny by pretending all pennies are perfect cylinders.

**Step 1:** Measure the diameter of a penny. Diameter = \_\_\_\_\_ mm

Step 2: Calculate the radius of the penny. Radius = \_\_\_\_\_ mm

Step 3: Measure the height of the penny.

First, measure the height of one coin individually. \_\_\_\_\_ mm.

Next, measure the height of 10 coins by stacking them.

Then divide your answer by 10.

Height of 1 coin = Height of 10 coins  $\div$  10

= \_\_\_\_ cm ÷ 10 = \_\_\_\_mm

Which answer for the height of one coin is more accurate? Explain.

**Step 4:** Calculate the volume of the penny using the radius and height you found.

b) Sara fills a graduated cylinder to the 30 mL mark. She then adds 10 pennies. Where should the water level be now?





# **ME8-14 Capacity**



### **ME8-15 Changing Units of Area and Volume**

- **1.** Use the picture to fill in the blanks. 1 cm 1 mm<sup>3</sup> a) c) b) 1 mm 1 cm 1 cm  $1 \text{ mm}^2$ 1 cm cm  $1 \, \text{cm}^2 = \text{mm}^2$ 1 cm = \_\_\_\_ mm  $1 \text{ cm}^3 = \text{mm}^3$ d) f) 1 km<sup>3</sup> cm  $1 \text{ km}^3 = \times \times \text{m}^3$  $1 m^2 = \times cm^2$  $1 \text{ m}^3 = \_\_ \times \_\_ \times \_\_ \text{ cm}^3$ = cm<sup>3</sup> = m<sup>3</sup> Cm<sup>2</sup> 2. Change the following units. a) 15 000 cm<sup>2</sup> to m<sup>2</sup> b) 460 cm<sup>3</sup> to mm<sup>3</sup> The new units are \_\_\_\_\_ times \_\_\_\_\_. The new units are  $100^2$  times bigger . So I need \_\_\_\_\_ times \_\_\_\_\_ units. So I need 10 000 times fewer units. So I \_\_\_\_\_\_ by \_\_\_\_\_. So I divide by 10 000 .  $15\ 000\ cm^2 = 1.5\ m^2$ 460 cm<sup>3</sup> = \_\_\_\_ mm<sup>3</sup> c) 15 000 m<sup>2</sup> to km<sup>2</sup> d) 460 mm<sup>3</sup> to cm<sup>3</sup> e) 4 mm<sup>2</sup> to m<sup>2</sup> f) 0.4 m<sup>3</sup> to cm<sup>3</sup> i) 2400 cm<sup>3</sup> to m<sup>3</sup> g)  $5.2 \text{ m}^2 \text{ to } \text{cm}^2$ h) 0.01 m<sup>3</sup> to cm<sup>3</sup> i) 0.01 m<sup>2</sup> to km<sup>2</sup> 3. Don says a rectangular prism with length 4 m, width 80 cm, and height 50 cm has a volume of 16 000 cm<sup>3</sup>. What mistake did he make? Explain. 4. a) A circle has circumference 0.16 m. What is its area in cm<sup>2</sup>? b) A rectangle has perimeter 0.16 m. Can you tell its area in cm<sup>2</sup> from this information? c) If the rectangle in part b) is a square, does that change your answer? 5. 1 cm<sup>2</sup> tiles cost 10¢ each. About how much would it cost to tile an area of 0.15 m<sup>2</sup>? Why is this only an approximation? 6. a) A circular pool has diameter 8 m and the water is 120 cm deep. How much water is in the pool? Write your answer in terms of m<sup>3</sup> and L. Which unit is a more reasonable unit of measurement?
  - b) During a drought year in a country with very little water, water costs \$7.50/m<sup>3</sup>. How much does it cost to fill the pool in part a)?

### **ME8-16 Surface Area of Prisms**

Note: Pictures are not drawn to scale.

1. In each prism, shade all the edges that have the same length as the edge marked.



2. Find the missing edge length for the prism.







3. Shade the face that has the same area as the shaded face.







4. The area of each visible face is given. What is the area of each hidden face?



5. Write the area of each visible face directly on the face. Then double each area to find the total area of each pair of congruent faces.



Measurement 8-16

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The **surface area** of a 3-D shape is the total area of all the faces of the shape.

6. Calculate the surface area of the prism.



7. Miki calculates the surface area of the prism to be 40 cm<sup>2</sup>. What did she do wrong?



- **8.** a) Alexandra says that she needs to find the area of only two faces of this prism to calculate the surface area. Is she correct? Explain.
  - b) What is the surface area of the prism?



**9.** Write the name of each face of the prism on the net, then mark the length of each edge on the net.



11. Find the missing length.



**13.** Edges *a*, *b*, and *c* have lengths that are whole numbers. The surface area of each face is written directly on the face. What are some possible lengths for edges *a*, *b*, and *c*? (Hint: Why can edge *a* not be 4 m long?)



- **14.** Write a formula for the surface area of the prism using the length ( $\ell$ ), width (w), and height (h).
- **15.** Calculate the surface area of the prism. Be careful with the units!



**16.** It costs \$0.40 per square metre to paint a room. How much would it cost to paint the walls of this room (not including the door and windows)?



# ME8-17 Surface Area of Cylinders



Measurement 8-17

5. A can of food is a cylinder. It has both top and bottom circles.



6 cm

b) Which net matches the can in part a)? What is wrong with the other net?



6. a) Which cylinder matches each net?



- b) Sketch nets for the two cylinders that were not matched.
- c) How does the surface area of a cylinder compare to the area of its net? Explain.
- Find the surface area of each can by first finding the area of a rectangle and the area of the top and bottom circles.



8. A cylindrical can has a circular base of radius *r* and height *h*. Write a formula for its surface area. Do not forget to include the top and bottom.

# ME8-18 Surface Area and Volume

**1.** Write one possible set of dimensions (length, width, and height) for a rectangular prism with the given volume.

b) 8 cm<sup>3</sup>

a) 12 cm<sup>3</sup>

c) 18 m³

- **2.** Find 3 possible sets of dimensions for a rectangular prism with volume 24 cm<sup>3</sup>. Which rectangular prism would require the least amount of material to construct?
- **3.** This is the top view (and mat plan) of a rectangular prism made of 1 cm<sup>3</sup> blocks:
  - a) What is its surface area in cm<sup>2</sup>?
  - b) What is its volume in cm<sup>3</sup>?
- 4. Find the volume and surface area of the shape. Explain your strategy.
- a) A prism has a square base that measures 10 cm by 10 cm. A cylinder has a base with the same area as the base of the prism.
  - b) If both the prism and the cylinder are 20 cm high, which container will require less material to make?
  - c) Do both containers have the same volume? Explain.
- 6. The two containers shown hold the same amount of pea soup.
  - a) How tall is the second container?
  - b) Find the surface area of each container.
  - c) It costs \$8 for each m<sup>2</sup> of metal to make a can. How much will it cost to make each can? Which can is cheaper?
- 7. Each square is 3 cm by 3 cm.
  - a) Find the area of the large circle.
  - b) Find the area of the 9 small circles.
  - c) Ten cylinders with height 5 cm and bases equal to the circles shown are made. Does the large cylinder hold more than, less than, or the same volume as the 9 smaller cylinders together?
- 8. Crystal knows that the surface areas of the front, top, and right faces of a prism add to 20 cm<sup>2</sup>. How can she find the **total** surface area of the prism? Explain.
- 9. Determine the capacity, volume, and surface area of the box.













- and surface area of each can.
- c) Which can has the larger volume and surface area?
- d) Which can has a lower cost of material per unit volume?

14. A cylinder has a radius and height that are whole numbers (measured in cm), and a volume of  $36 \times \pi$  cm<sup>2</sup>. What is the smallest surface area it can have?