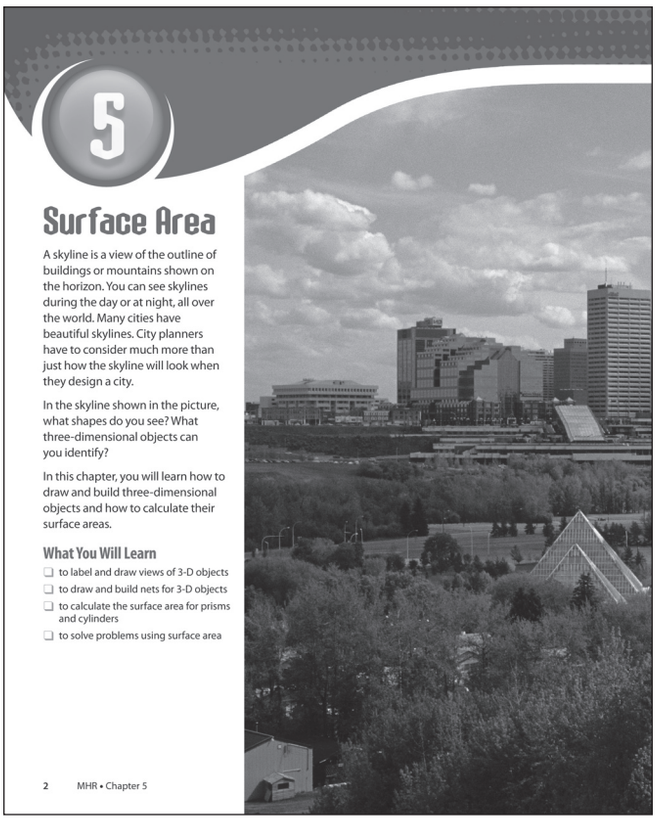
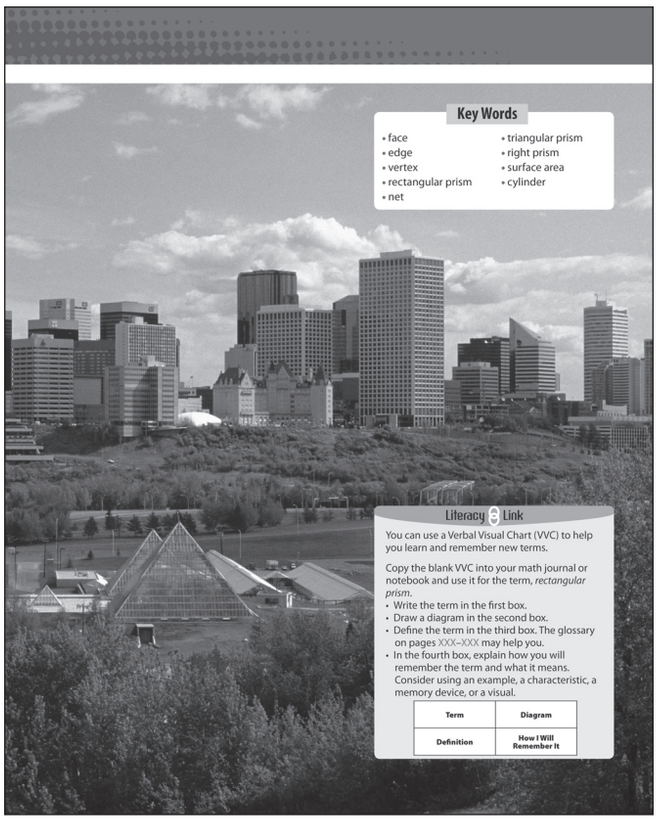




***MathLinks 8*, pages xx–xx**

Suggested Timing
20–30 minutes

Materials
- 11 × 17 sheet of paper
- four sheets of blank paper
- ruler
- scissors
- glue or tape
- stapler

Blackline Masters
BLM 5–1 Chapter Opener Math Link
BLM 5–2 Chapter 5 Get Ready
BLM 5–3 Chapter 5 Warm-Up
BLM 5–4 Chapter 5 Problems of the Week

Key Words
face, edge, vertex, rectangular prism, right prism, surface area, cylinder

What's the Math?

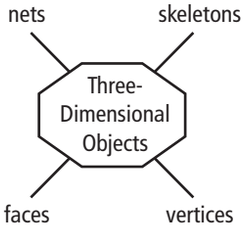
In this chapter, students learn about three-dimensional geometry. Students begin by investigating top, front, and side views of 3-D objects, and then sketch objects from different views. Students also learn how to draw nets, build 3-D objects from nets, and determine correct nets for different objects. Finally, they determine how to calculate the surface area of prisms and cylinders.

Planning Notes

Before beginning Chapter 5, have students work individually or in pairs to complete a word splash on a piece of paper. Ask students to include everything they remember about three-dimensional objects.

For example:

When students are done, gather all their ideas and create a large word splash to post in the classroom. Make any additions as they come up throughout the chapter.

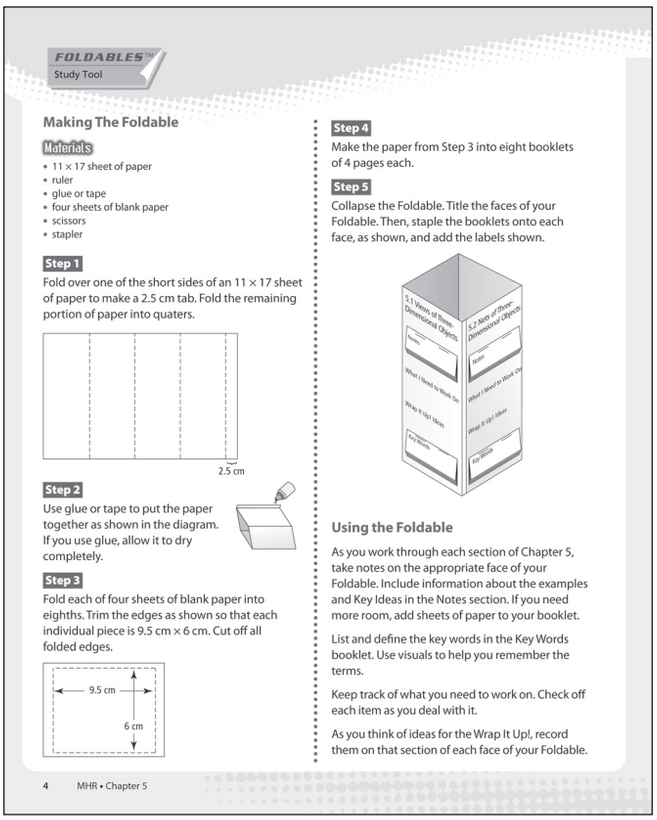


Have students look at the picture of Edmonton's skyline in the student text and ask them to identify shapes and three-dimensional figures.

Literacy Link The Verbal Visual Chart strategy is helpful for vocabulary development and may be used throughout this chapter as new vocabulary is introduced or old vocabulary reinforced. By creating a graphic organizer that contains each term and its definition, along with a visual and a personal association, students deepen their understanding of the essential characteristics of a concept.

At the beginning of Chapter 5, coach students as they create a VVC for the term *rectangular prism*. Allow time for students to share their ideas with the class. You may wish to brainstorm different associations for the term.

Work as a class to develop a memory device for remembering what a rectangular prism is. As students work on Section 5.1, you may wish to develop several VVCs that help them differentiate between the terms face, edge, and vertex.



FOLDABLES™
Study Tool

Making The Foldable

Materials

- 11 × 17 sheet of paper
- ruler
- glue or tape
- four sheets of blank paper
- scissors
- stapler

Step 1

Fold over one of the short sides of an 11 × 17 sheet of paper to make a 2.5 cm tab. Fold the remaining portion of paper into quaters.

2.5 cm

Step 2

Use glue or tape to put the paper together as shown in the diagram. If you use glue, allow it to dry completely.

Step 3

Fold each of four sheets of blank paper into eighths. Trim the edges as shown so that each individual piece is 9.5 cm × 6 cm. Cut off all folded edges.

9.5 cm
6 cm

Step 4

Make the paper from Step 3 into eight booklets of 4 pages each.

Step 5

Collapse the Foldable. Title the faces of your Foldable. Then, staple the booklets onto each face, as shown, and add the labels shown.

5.1 Views of Three-Dimensional Objects
Notes
What I Need to Work On
Wrap It Up! Ideas
Key Words
5.2 Nets of Three-Dimensional Objects
Notes
What I Need to Work On
Wrap It Up! Ideas
Key Words

Using the Foldable

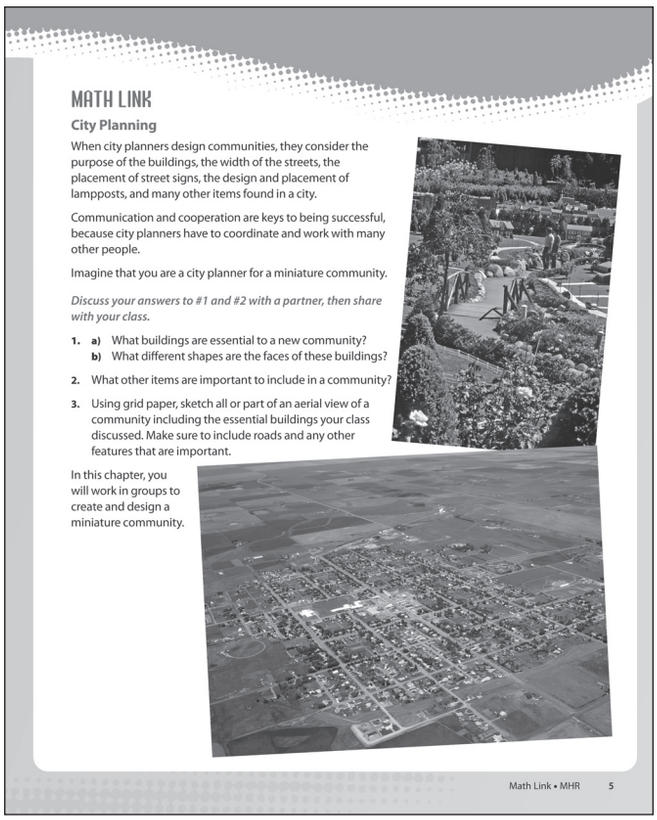
As you work through each section of Chapter 5, take notes on the appropriate face of your Foldable. Include information about the examples and Key Ideas in the Notes section. If you need more room, add sheets of paper to your booklet.

List and define the key words in the Key Words booklet. Use visuals to help you remember the terms.

Keep track of what you need to work on. Check off each item as you deal with it.

As you think of ideas for the Wrap It Up!, record them on that section of each face of your Foldable.

4 MHR • Chapter 5



MATH LINK

City Planning

When city planners design communities, they consider the purpose of the buildings, the width of the streets, the placement of street signs, the design and placement of lampposts, and many other items found in a city.

Communication and cooperation are keys to being successful, because city planners have to coordinate and work with many other people.

Imagine that you are a city planner for a miniature community.

Discuss your answers to #1 and #2 with a partner, then share with your class.

1. a) What buildings are essential to a new community?
   b) What different shapes are the faces of these buildings?
2. What other items are important to include in a community?
3. Using grid paper, sketch all or part of an aerial view of a community including the essential buildings your class discussed. Make sure to include roads and any other features that are important.

In this chapter, you will work in groups to create and design a miniature community.

Math Link • MHR 5

Foldables Study Tool

Have students make the Foldable in the student resource to keep track of the information in the chapter. You might have students work in pairs on their Foldables. For Step 1, have them first create the tab, and then divide the paper into quarters as shown.

Putting the Foldable together with tape provides a stronger seam. The disadvantage to this technique is that most pens cannot write across the tape.

Make sure that students measure the papers for their little notebooks so that they will fit on the face of the Foldable. Have them staple the top booklet from the top of the Foldable and the bottom booklet from the bottom of the Foldable. Students will need more or less paper in these booklets, depending on their note-taking skills and the size of their hand-writing.

There is no room on this Foldable for the Math Links that students will complete throughout the chapter. You may with to have students keep track of this work in their math portfolios. Alternatively, if you have provided a plastic envelope for storing the Foldables, you might have them store the Math Links work in that envelope as well.

Math Link

The Math Link for this chapter is about city planning. Begin with a class discussion and ask some questions like these:

- How are cities started?
- Who decides where they are built?

Have students form pairs to work through the questions for the Math Link. These questions direct students to look at buildings and notice the shapes that create them. Throughout the Math Links in this chapter, students will design parts of a community, and, at the end of the chapter, these parts will be used to create a miniature.

Meeting Student Needs

- Have students work individually, in partners, or as a whole class to complete the opener or Math Link, depending on the needs of your class.
- Provide students who are having difficulty getting started with **BLM 5–1 Math Link Introduction**, which provides scaffolding for this activity.
- Invite a city or community planner to talk to the class about how the process of designing a community starts. For example, discussing the design of a farming town or a First Nations village will help students prepare for the Math Links in this chapter.

- Take a digital photograph of the skyline of your community, enlarge it, and display it in the classroom. Have students list the shapes they see in the community skyline. Then, compare the list with the list of the shapes seen in Edmonton's skyline in the student text.
- Have students research a famous structure in their community or in a nearby city (for example, one of Doug Cardinal's famous structures, one of the buildings in Edmonton's skyline, etc.). Ask students to identify some of the different shapes used to create the buildings.
- Have students use small cards for their VVCs. By making a VVC for each important word in the chapter, students can develop a small deck of cards that they can use for review. Students might wish to make a duplicate set of cards that they cut into four pieces, shuffle with other cards from the chapter, and then reassemble to show that they remember the meaning, visual reminder, and association for each key term.
- Have students label the face, edge, and vertex in their VVC for *rectangular prism*.

ELL

- Students may have difficulty with vocabulary such as *horizon, miniatures, essentials*, and *city planner*. Make sure to review these words with the students.

Gifted and Enrichment

- Introduce the term *mnemonic* as a synonym for memory device.

Answers

Chapter Opener

1. a) Answers may vary. For example, a hospital, a fire hall, and a police station are essential to a new community.

b) Many of the faces are squares, rectangles, and triangles.

2. Answers may vary. For example, a community centre, gas stations, and roads are also important to include in a new community.

3. Answers may vary.

Views of Three-Dimensional Objects

5.1

***MathLinks 8*, pages xx–xx**

Suggested Timing
80–100 minutes

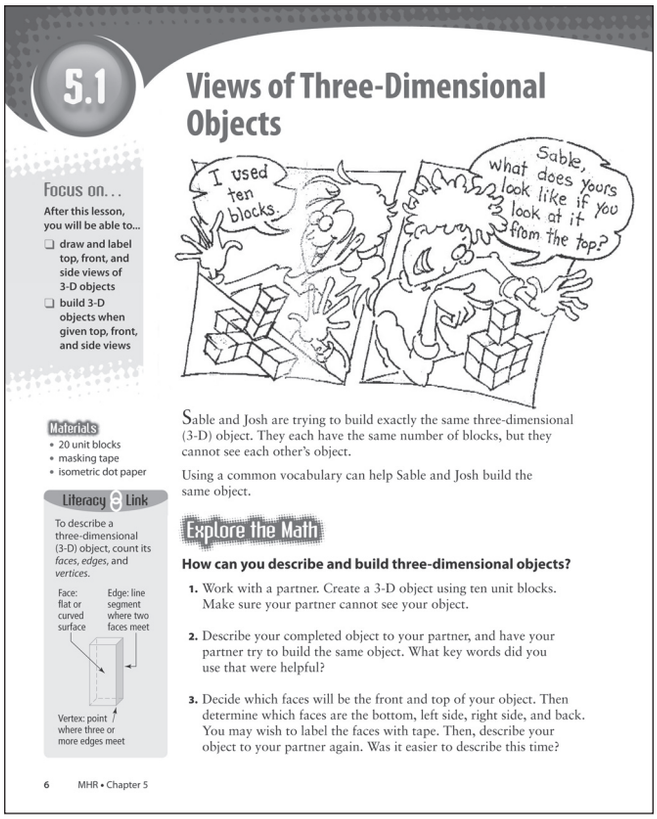
Materials
- 20 unit blocks
- masking tape
- isometric dot paper

Blackline Masters
Master 7 Isometric Dot Paper
BLM 5–3 Chapter 5 Warm-Up
BLM 5–5 Section 5.1 Communication Activity
BLM 5–6 Section 5.1 Extra Practice
BLM 5–7 Section 5.1 Math Link

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☐ Mental Mathematics and Estimation (ME)
- ☐ Problem Solving (PS)
- ☑ Reasoning (R)
- ☐ Technology (T)
- ☑ Visualization (V)

Specific Outcomes
SS5 Draw and interpret top, front and side views of 3-D objects composed of right rectangular prisms.

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1, 2, 3a), b), or c), 4, 5, 7a) or b), 8, Math Link
Typical	1, 2, 3a), b), or c), 4, 6, 7a) or b), 8, 12a), b), or c), Math Link
Extension/Enrichment	3a), b), or c), 8–12, Math Link


5.1

Views of Three-Dimensional Objects

Focus on...
After this lesson, you will be able to...
- ❑ draw and label top, front, and side views of 3-D objects
- ❑ build 3-D objects when given top, front, and side views

Materials
- 20 unit blocks
- masking tape
- isometric dot paper

Literacy Link
To describe a three-dimensional (3-D) object, count its *faces*, *edges*, and *vertices*.

Sable and Josh are trying to build exactly the same three-dimensional (3-D) object. They each have the same number of blocks, but they cannot see each other's object.

Using a common vocabulary can help Sable and Josh build the same object.

Explore the Math

How can you describe and build three-dimensional objects?

1. Work with a partner. Create a 3-D object using ten unit blocks. Make sure your partner cannot see your object.
2. Describe your completed object to your partner, and have your partner try to build the same object. What key words did you use that were helpful?
3. Decide which faces will be the front and top of your object. Then determine which faces are the bottom, left side, right side, and back. You may wish to label the faces with tape. Then, describe your object to your partner again. Was it easier to describe this time?

6 MHR • Chapter 5

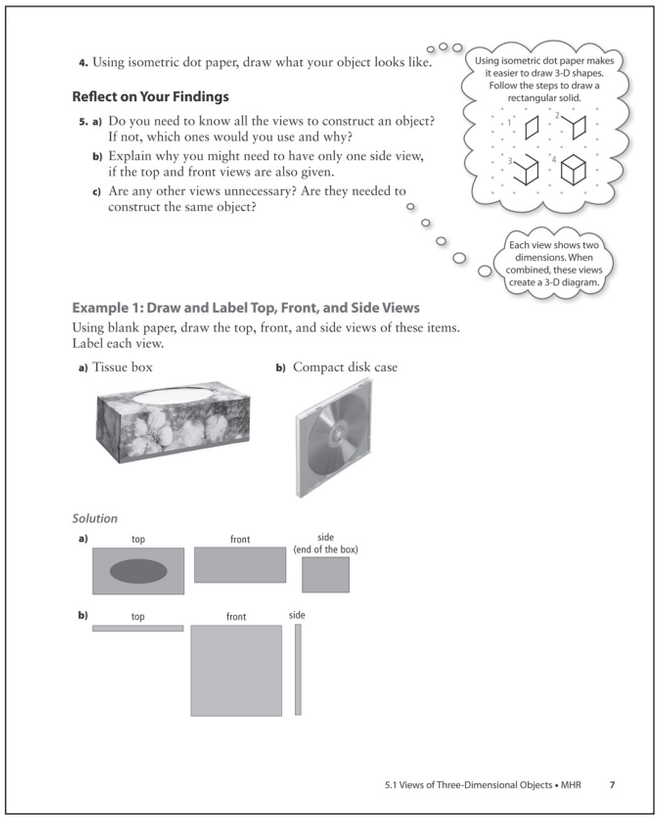
Planning Notes

Have students complete the warm-up questions on **BLM 5–3 Chapter 5 Warm-Up** to reinforce material learned in previous sections.

Start the lesson with an activity involving communication and using common vocabulary. Have students work in pairs. Give one student in each pair a copy of **BLM 5–5 Section 5.1 Communication Activity**, ensuring the other student cannot see it. Have the student with the picture describe the object in words, using vocabulary from this chapter, while the other student draws what the student describes. Have students compare the drawing with the picture when they are finished. Then, as a class, discuss how all students could have improved their communication, emphasizing that using a common mathematical language would help in completing this activity.

Explore the Math

This activity follows directly from the communication activity described above. Prior to completing #4 (drawing an object on isometric dot paper), you may want to do a brief lesson on the overhead to show students how to draw connected cubes on this type of paper (see Literacy Link on page XX). Students should discover that the minimum number of views needed to describe a 3-D object is three: top, front, and side views.


4. Using isometric dot paper, draw what your object looks like.

Using isometric dot paper makes it easier to draw 3-D shapes. Follow the steps to draw a rectangular solid.

Reflect on Your Findings

5. a) Do you need to know all the views to construct an object? If not, which ones would you use and why?
   b) Explain why you might need to have only one side view, if the top and front views are also given.
   c) Are any other views unnecessary? Are they needed to construct the same object?

Each view shows two dimensions. When combined, these views create a 3-D diagram.

Example 1: Draw and Label Top, Front, and Side Views

Using blank paper, draw the top, front, and side views of these items. Label each view.

a) Tissue box

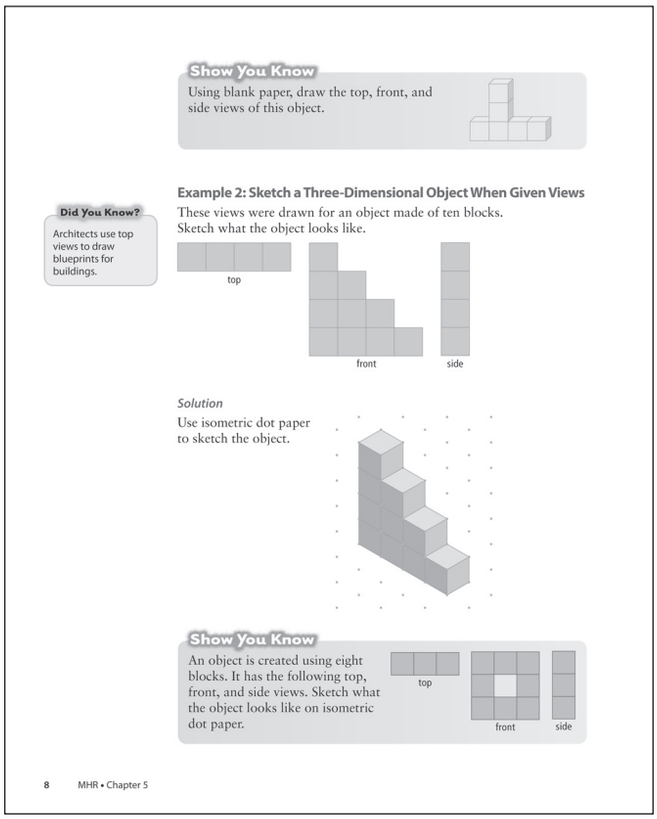
b) Compact disk case

Solution

a) top, front, side (end of the box)

b) top, front, side

5.1 Views of Three-Dimensional Objects • MHR 7


Show You Know

Using blank paper, draw the top, front, and side views of this object.

Did You Know?

Architects use top views to draw blueprints for buildings.

Example 2: Sketch a Three-Dimensional Object When Given Views

These views were drawn for an object made of ten blocks. Sketch what the object looks like.

top, front, side

Solution

Use isometric dot paper to sketch the object.

Show You Know

An object is created using eight blocks. It has the following top, front, and side views. Sketch what the object looks like on isometric dot paper.

top, front, side

8 MHR • Chapter 5

Example 1

Ensure that students understand that the views are relative to the picture, and are not just rectangles or squares of any size. You may wish to have students complete the Show You Know on isometric dot paper (use **Master 7 Isometric Dot Paper**).

Example 2

Some students may benefit from having a rectangular prism, such as a cardboard box, available to demonstrate the actual rotation. Make sure to begin with the same top, front, and side views as those shown in the textbook.

Example 3

Have students practise drawing Example 3 on isometric dot paper, then have them complete the Show You Know section on the same piece of paper.

Meeting Student Needs

- Provide students with unit blocks that they can manipulate to help them draw the top, front, and side views.
- Before beginning Example 1, have each student choose an object in the room and label the top, front, sides, and bottom of the object.
- To complete the Show You Know for Example 1, have the students first construct the object out of unit blocks, then draw it.
- Have students work in partners to construct at least two more objects from unit blocks and draw the top, front, and sides of these objects before moving on to Example 2.
- Before attempting Example 2, construct an object from unit blocks and have the students verbally label the top, front, and sides of the object. Ask the students to predict what the top, face, and sides of the object would look like if the object were rotated 90° clockwise. Then, turn the object and check.

Common Errors

- Some students may have difficulty realizing that the views are relative to the picture.

R_x Ensure students draw the top view from the front view.

- Some students may have difficulty sizing their drawings.

R_x Remind students to make drawings of top, front, and side views relative in size (e.g., make sure they do not draw a top view that is longer than the front view).

ELL

- Review the meaning of *rotation* and *clockwise*. In addition, review the number of degrees in a circle and discuss how far around the circle 90°, 180°, 270°, and 360° are. Have the students stand up and rotate the specified number of degrees as you call them out.
- Have students with common languages work in pairs for the investigation so they can clearly communicate and understand the importance of the descriptive language necessary for describing three-dimensional shapes.

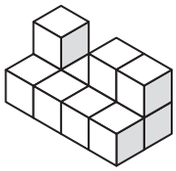
Web Link

Have students create a drawing of unit blocks on isometric dot paper and colour-code it, rotate it from points x, y, and z, and colour the faces of the blocks. Go to www.mathlinks8.ca and follow the links.

Answers

Explore the Math

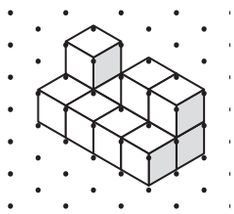
1. Answers may vary. For example,



2. Answers may vary. For example: "It looks like a park bench with four seats, where the second seat from the left does not have a back." The number *four* was helpful.

3. Answers may vary. For example: From the front, you see two rows of four blocks, with the second block from the left missing in the upper row. From the top, you see the same view. From the left side, you see three blocks arranged in the shape of the capital L. Yes, it was easier to describe.

4. Answers may vary. For example,



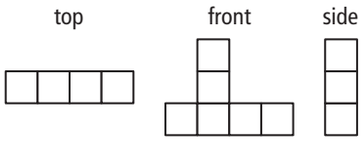
Reflect on Your Findings

5. a) No; the top, front, and side views are usually sufficient to describe an object.

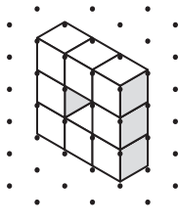
b) The two side views are often the same or one view is the opposite of the other.

c) Yes, the bottom and the back are also unnecessary. They are, respectively, identical to or are opposites of the top and front views.

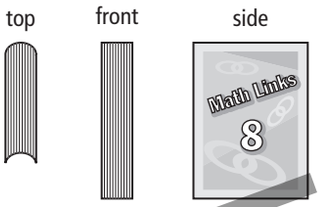
Example 1: Show You Know



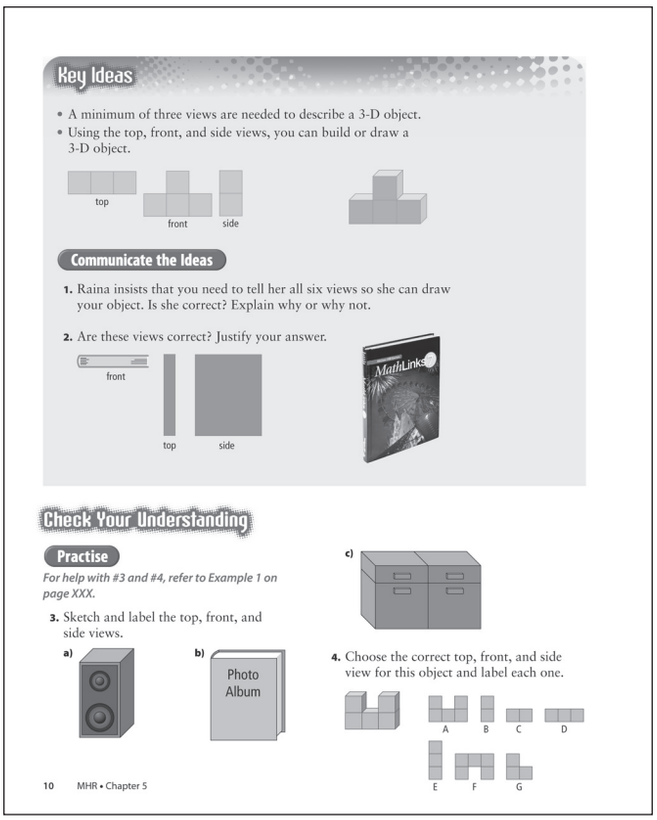
Example 2: Show You Know



Example 3: Show You Know



Assessment	Supporting Learning
Assessment *as* Learning	
Reflect on Your Findings Listen as students discuss what they discovered during the Explore the Math. Encourage students to generalize and reach a conclusion from their findings. Students should conclude and be able to justify that only three views are needed: top, front, and side.	• Tell students who are struggling to look at the top and the bottom of the object. Are they the same? Are the front and the back the same? • Ask these to students trace some of the faces on a paper, cut them out, and reconstruct a model, as this may help clarify the concept.
Assessment *for* Learning	
Example 1 Have students do the Show You Know related to Example 1.	• Encourage students to verbalize their thinking. • Have students work in partners. • Encourage students to build the object out of unit blocks to help them draw the views, or to trace and cut out the pieces, putting them back together with tape. • You may wish to give students an additional picture to check for understanding. For example: 
Example 2 Have students do the Show You Know related to Example 2.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • For continuity, make sure all students have the front cover of the textbook as their front view. If not, consider all the different possible answers. • Assist struggling students by working through one view to help them start, then let them finish the remaining two views. • Encourage students to build the object out of unit blocks, to help them draw the views, or to trace and cut out the pieces, putting them back together with tape.
Example 3 Have students do the Show You Know related to Example 3.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Some students may benefit from building the object to show their understanding if they are having difficulty drawing on isometric dot paper. Alternatively, assist students with their drawings.



Key Ideas

- A minimum of three views are needed to describe a 3-D object.
- Using the top, front, and side views, you can build or draw a 3-D object.

top front side

Communicate the Ideas

1. Raina insists that you need to tell her all six views so she can draw your object. Is she correct? Explain why or why not.

2. Are these views correct? Justify your answer.

front top side

Check Your Understanding

Practise

For help with #3 and #4, refer to Example 1 on page XXX.

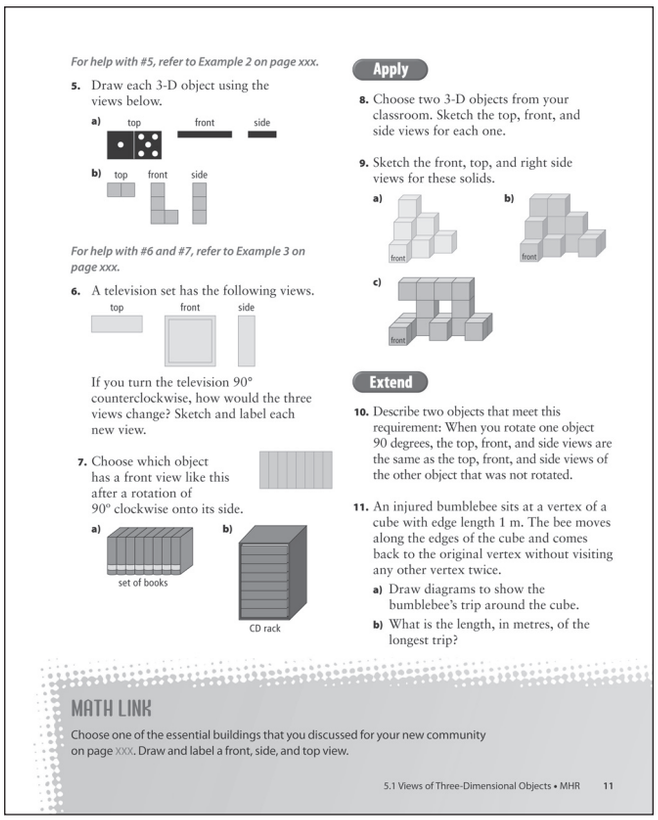
3. Sketch and label the top, front, and side views.

a) **b)** Photo Album **c)**

4. Choose the correct top, front, and side view for this object and label each one.

A B C D E F G

10 MHR • Chapter 5



For help with #5, refer to Example 2 on page xxx.

5. Draw each 3-D object using the views below.

a) top front side

b) top front side

For help with #6 and #7, refer to Example 3 on page xxx.

6. A television set has the following views.

top front side

If you turn the television 90° counterclockwise, how would the three views change? Sketch and label each new view.

7. Choose which object has a front view like this after a rotation of 90° clockwise onto its side.

a) set of books **b)** CD rack

Apply

8. Choose two 3-D objects from your classroom. Sketch the top, front, and side views for each one.

9. Sketch the front, top, and right side views for these solids.

a) **b)** **c)**

Extend

10. Describe two objects that meet this requirement: When you rotate one object 90 degrees, the top, front, and side views are the same as the top, front, and side views of the other object that was not rotated.

11. An injured bumblebee sits at a vertex of a cube with edge length 1 m. The bee moves along the edges of the cube and comes back to the original vertex without visiting any other vertex twice.

a) Draw diagrams to show the bumblebee's trip around the cube.

b) What is the length, in metres, of the longest trip?

MATH LINK

Choose one of the essential buildings that you discussed for your new community on page XXX. Draw and label a front, side, and top view.

5.1 Views of Three-Dimensional Objects • MHR 11

Key Ideas

Encourage students to relate the Key Ideas to the Communicate the Ideas. For example, have students compare the top, front, and side views of the shape with the shape itself in the Key Ideas section, then work on #2.

Communicate the Ideas

The Communicate the Ideas gives students an opportunity to explain their understanding of the number of views required to describe a 3-D object, and of what views are required to build or draw a 3-D object. Have students complete both questions to show their understanding.

Meeting Student Needs

- To help students with #2, encourage them to physically rotate their textbooks.
- You may wish to provide **BLM 5–6 Section 5.1 Extra Practice** to students who require more practice. You will find the answers to this master on **BLM 5–18 Chapter 5 BLM Answers**.

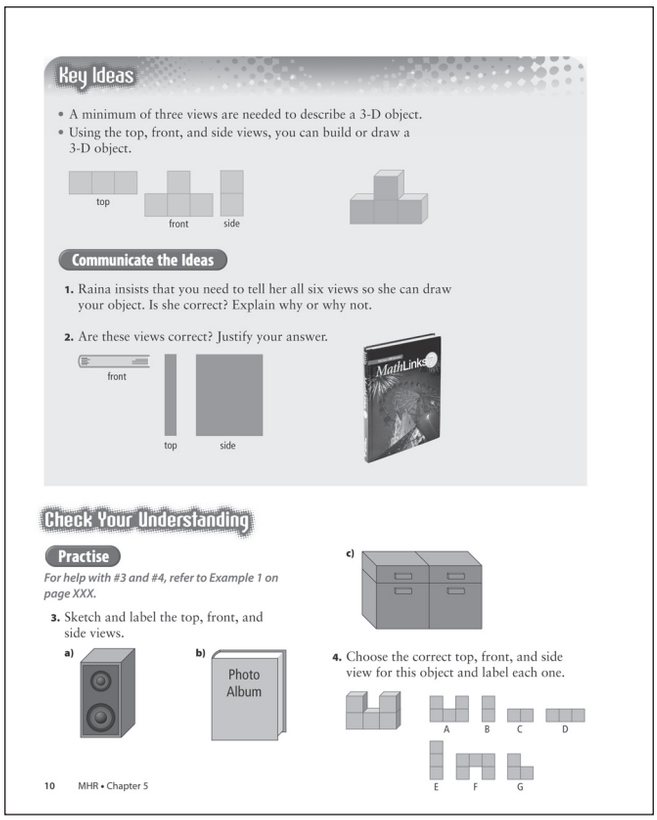
Answers

Communicate the Ideas

1. No, three views, top, front, and side, are sufficient to draw the object.

2. The views are labelled incorrectly. The front should be the top, the top should be the side, and the side should be the front.

Assessment	Supporting Learning
Assessment *as* Learning	
Communicate the Ideas Have all students complete #1 and #2 to show their understanding of top, front, and side views.	• Allow students who struggle with #1 and #2 to discuss the answers with a classmate, and then record their responses on their own. • Encourage students to build similar objects out of unit blocks to help them draw the views or to trace and cut out the pieces, putting them back together with tape. Have them label the pieces to help them visualize the picture.



Key Ideas

- A minimum of three views are needed to describe a 3-D object.
- Using the top, front, and side views, you can build or draw a 3-D object.

top front side

Communicate the Ideas

1. Raina insists that you need to tell her all six views so she can draw your object. Is she correct? Explain why or why not.
2. Are these views correct? Justify your answer.

front top side

Check Your Understanding

Practise

For help with #3 and #4, refer to Example 1 on page XXX.

3. Sketch and label the top, front, and side views.

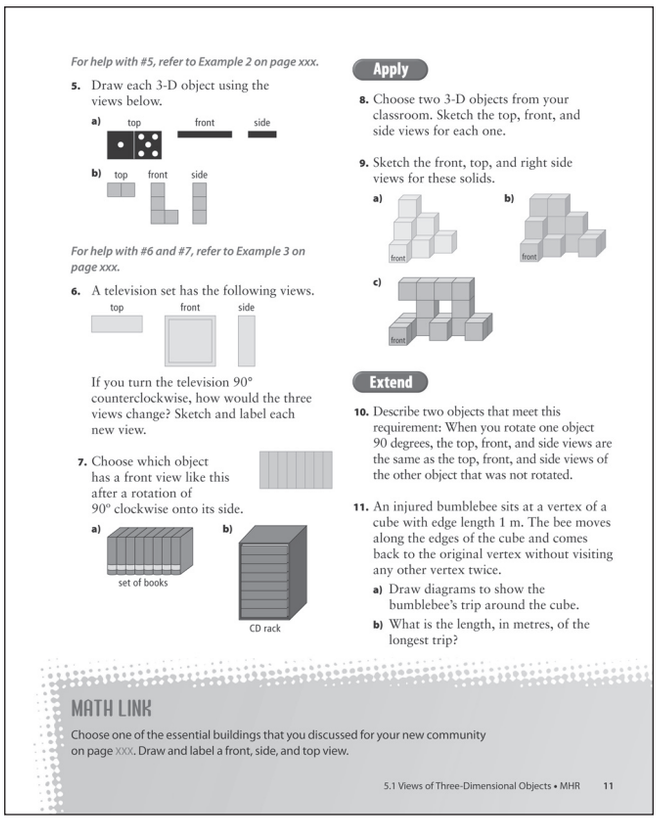
a) b) Photo Album

c)

4. Choose the correct top, front, and side view for this object and label each one.

A B C D E F G

10 MHR • Chapter 5



For help with #5, refer to Example 2 on page xxx.

5. Draw each 3-D object using the views below.

a) top front side

b) top front side

For help with #6 and #7, refer to Example 3 on page xxx.

6. A television set has the following views.

top front side

If you turn the television 90° counterclockwise, how would the three views change? Sketch and label each new view.

7. Choose which object has a front view like this after a rotation of 90° clockwise onto its side.

a) set of books b) CD rack

Apply

8. Choose two 3-D objects from your classroom. Sketch the top, front, and side views for each one.
9. Sketch the front, top, and right side views for these solids.

a) b) c)

Extend

10. Describe two objects that meet this requirement: When you rotate one object 90 degrees, the top, front, and side views are the same as the top, front, and side views of the other object that was not rotated.
11. An injured bumblebee sits at a vertex of a cube with edge length 1 m. The bee moves along the edges of the cube and comes back to the original vertex without visiting any other vertex twice.
    a) Draw diagrams to show the bumblebee's trip around the cube.
    b) What is the length, in metres, of the longest trip?

MATH LINK

Choose one of the essential buildings that you discussed for your new community on page XXX. Draw and label a front, side, and top view.

5.1 Views of Three-Dimensional Objects • MHR 11

Check Your Understanding

Practise

Have students work in pairs or small groups to complete the questions in this section. Students should discuss the work and agree on answers. For #6, remind students that counter-clockwise means rotating to the left.

Apply

Provide isometric dot paper for students to use to answer #8. For #8 and #9, encourage students to use objects that interest them.

You may wish to build #10 a) and have students sketch the view, then discuss how they could determine the views without having the 3-D object in front of them. Have them do b) individually, then compare it to the actual 3-D object built from centimetre cubes.

Extend

You may wish to have various shapes available in the classroom for #11.

Students may find it helpful to have a cube when doing #12.

Math Link

This Math Link is the first step in designing and possibly building the miniature community put together in the Wrap It Up! Essential buildings include those that students determined to be vital to any community in their discussions in the Chapter Opener.

Encourage students to use only one object, not combined objects.

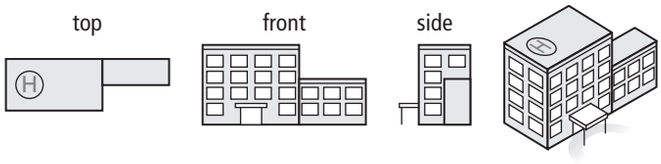
Meeting Student Needs

- Provide students with unit blocks to manipulate to help them draw the top, front, and side views.
- Have students research and create a poster of three-dimensional objects that are commonly found in the students' community or culture (e.g., Aboriginal drums, boxes for ceremonial objects, other artifacts).

Answers

Math Link

Answers may vary. For example, a hospital:



Assessment	Supporting Learning
Assessment *for* Learning	
Practice Have students do #3a), b) *or* c), 4, 5, 7a) *or* b) and 8. Students who can readily complete these questions can go on to the Apply questions.	• Encourage students who are kinesthetic or concrete learners and need help with #3to use their textbook or a box in the classroom. Encourage them to trace the sides and label them. Have them try #3b) before going on. • Students who need assistance with #4 may wish to use blocks to complete the question on a smaller scale. Ask these students to verbalize what they see before trying #4 again. • For #5, some students may benefit from trying the rotating with their textbooks first, verbalizing how the shape changes after the rotation. They may wish to work on #5 before going on. • For #7, have students explain their thinking to you, so you can clarify any misunderstandings. Students may benefit from drawing a larger version of the question, cutting it out, and taping the pieces together in order to see the 3-D object it creates. Have students explain verbally #7b). Ask them to describe how the top and front view given fit together.
Math Link The Math Link on page xx is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page xx.	• All students will benefit from completing the Math Link, as it directly relates to the activity assigned in the Wrap It Up! at the end of the chapter. • Students may have difficulties deciding on an essential building or they may not be certain what their chose building might look like. Provide suggestions if needed (e.g., a hospital might be a rectangular prism). • **BLM 5–7 Section 5.1 Math Link** provides scaffolding that will help some students complete the Math Link.
Assessment *as* Learning	
Math Learning Log Have students complete the following statements: –I need only three views to draw a three-dimensional object because … –The view I find the most difficult to draw is …	• Encourage students to look back through their work for ideas to help answer the questions. • Encourage students to use the What I Need to Work On section of their chapter Foldable to note what they continue to have difficulty with.

5.2 Nets of Three-Dimensional Objects

***MathLinks 8*, pages xx–xx**

Suggested Timing
80–120 minutes

Materials
- scissors
- clear tape
- rectangular prisms (e.g., blocks of wood, cardboard boxes, unit blocks)

Blackline Masters
Master 8 Centimetre Grid Paper
BLM 5–3 Chapter 5 Warm-Up
BLM 5–8 Section 5.2 Example 2
BLM 5–9 Section 5.2 Extra Practice
BLM 5–10 Section 5.2 Math Link

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☐ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☐ Reasoning (R)
- ☐ Technology (T)
- ☑ Visualization (V)

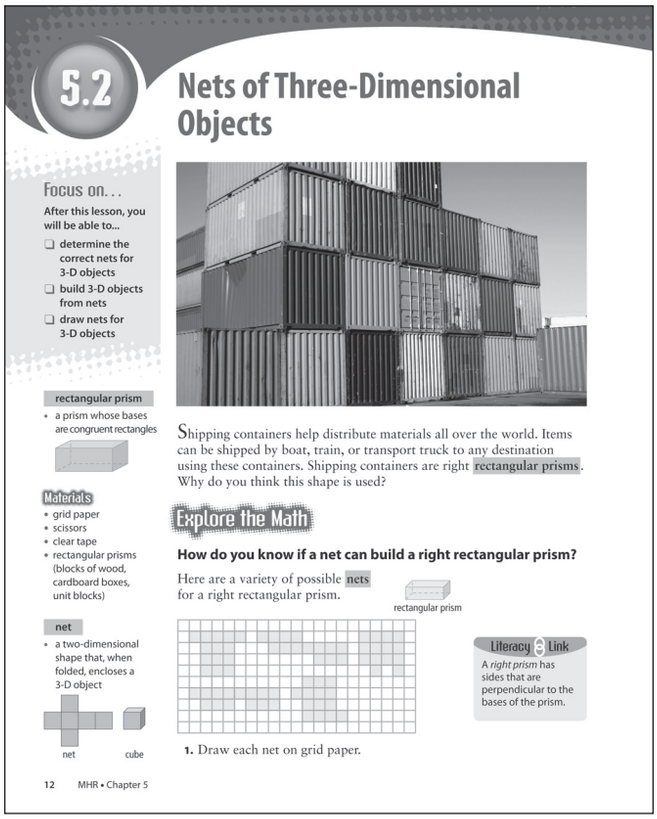
Specific Outcomes
SS2 Draw and construct nets for 3-D objects.

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1, 3, 7, 10, Math Link
Typical	1, 3, 6–8, 10, 13, Math Link
Extension/Enrichment	1, 9–13, Math Link

Planning Notes

Have students complete the warm up questions on **BLM 5–3 Chapter 5 Warm-Up** to reinforce material learned in previous sections.

Start the lesson by discussing the shipping container illustration. Have students describe how the container would look before it is built. Ensure students understand that the containers start as pieces that are put together to form the container.



5.2 Nets of Three-Dimensional Objects

Focus on...
After this lesson, you will be able to...
- ❑ determine the correct nets for 3-D objects
- ❑ build 3-D objects from nets
- ❑ draw nets for 3-D objects

rectangular prism
- a prism whose bases are congruent rectangles

Shipping containers help distribute materials all over the world. Items can be shipped by boat, train, or transport truck to any destination using these containers. Shipping containers are right rectangular prisms. Why do you think this shape is used?

Materials
- grid paper
- scissors
- clear tape
- rectangular prisms (blocks of wood, cardboard boxes, unit blocks)

Explore the Math

How do you know if a net can build a right rectangular prism?

Here are a variety of possible nets for a right rectangular prism.

rectangular prism

net
- a two-dimensional shape that, when folded, encloses a 3-D object

net cube

Literacy Link
A *right prism* has sides that are perpendicular to the bases of the prism.

1. Draw each net on grid paper.

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Explore the Math

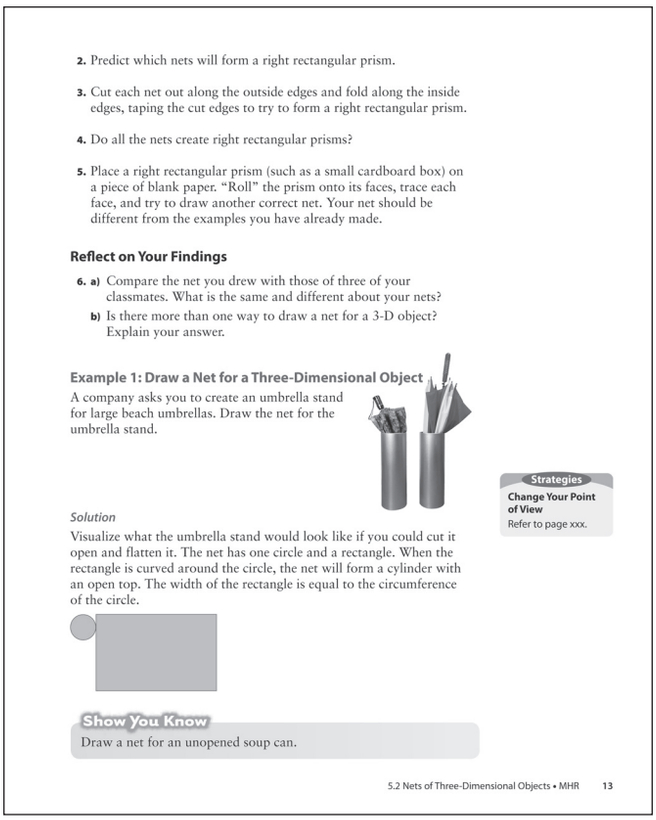
Start students off by reviewing the definitions of rectangular prism and net in the margin of the textbook. Distribute **Master 8 Centimetre Grid Paper** to each student. Ensure students understand how the prism can be "unfolded" to create a net, and the net "folded" to create the prism. Have students work in pairs to discuss their predictions for #2, then share the cutting and taping tasks. For #5, have students use the rectangular prism that worked in #3 to try to draw a different net.

Example 1

After students have read Example 1, point out that the size of the circle is related to the length of the edge it is attached to. Have students do the Show You Know and share their nets with a classmate.

Example 2

Point out the definition of triangular prism in the margin. Have students work through the example and the Show You Know and share their solutions with a classmate.



2. Predict which nets will form a right rectangular prism.

3. Cut each net out along the outside edges and fold along the inside edges, taping the cut edges to try to form a right rectangular prism.

4. Do all the nets create right rectangular prisms?

5. Place a right rectangular prism (such as a small cardboard box) on a piece of blank paper. "Roll" the prism onto its faces, trace each face, and try to draw another correct net. Your net should be different from the examples you have already made.

Reflect on Your Findings

6. a) Compare the net you drew with those of three of your classmates. What is the same and different about your nets?
   b) Is there more than one way to draw a net for a 3-D object? Explain your answer.

Example 1: Draw a Net for a Three-Dimensional Object

A company asks you to create an umbrella stand for large beach umbrellas. Draw the net for the umbrella stand.

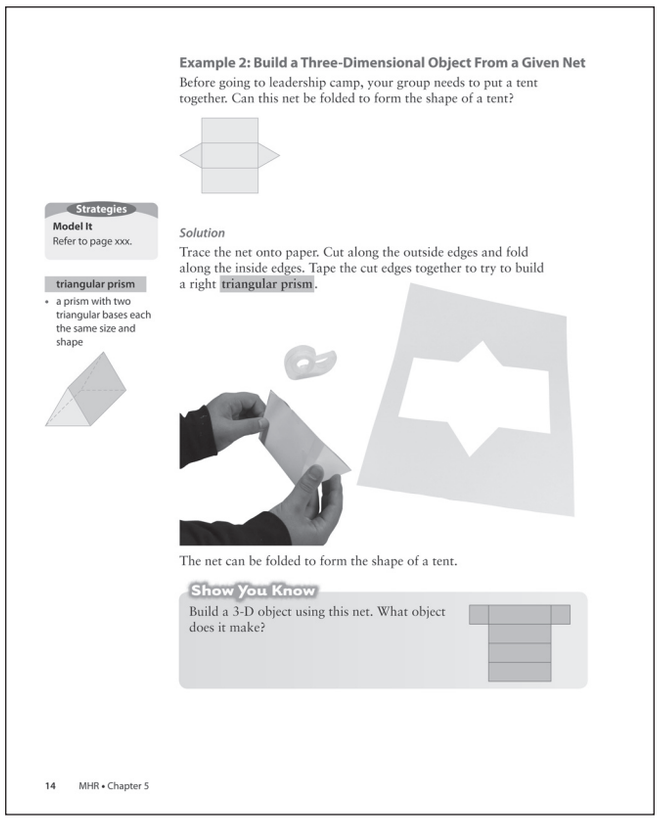
Strategies
Change Your Point of View
Refer to page xxx.

Solution

Visualize what the umbrella stand would look like if you could cut it open and flatten it. The net has one circle and a rectangle. When the rectangle is curved around the circle, the net will form a cylinder with an open top. The width of the rectangle is equal to the circumference of the circle.

Show You Know
Draw a net for an unopened soup can.

5.2 Nets of Three-Dimensional Objects • MHR 13



Example 2: Build a Three-Dimensional Object From a Given Net

Before going to leadership camp, your group needs to put a tent together. Can this net be folded to form the shape of a tent?

Strategies
Model It
Refer to page xxx.

triangular prism
- a prism with two triangular bases each the same size and shape

Solution

Trace the net onto paper. Cut along the outside edges and fold along the inside edges. Tape the cut edges together to try to build a right triangular prism.

The net can be folded to form the shape of a tent.

Show You Know
Build a 3-D object using this net. What object does it make?

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Meeting Student Needs

- Discuss materials and supplies that are shipped by shipping containers. For example, Nunavut communities have yearly supplies of food, building materials, fuel, etc., shipped by barge or ship in crates and shipping containers. The Red Cross and other Canadian charitable organizations ship containers of food and medical supplies to places around the world where these are needed.
- Discuss how shipping crates can be taken apart and reused and large ones can form storage sheds and garages with little alteration. Relate nets and rectangular prisms to the process of dismantling a crate. Discuss the relationship between the top, bottom, and sides. If a crate were spread out flat, what shape would it make? Can it be arranged in different shapes and still form a crate when reassembled?
- For Example 2, students may find it challenging to trace the small picture or cut it out or tape it. You may wish to provide students (or groups of students) with **BLM 5–8 Section 5.2 Example 2** to cut and tape.
- Provide cans and/or other cylinders that students can trace to create nets if they have difficulty visualizing and drawing cylindrical nets.
- Provide larger cutouts for students who have difficulties with motor skills. Students can also compare their own examples with the larger samples.
- Have students verbalize their answers if they are having difficulties with written explanations.

Common Errors

- Some students may have difficulty drawing nets.

R_x Ensure students connect the shapes in the net. Students may have all the pieces, but not so they form a net. Make sure there are no overlapping pieces or a hole where there should be a side.

- Some students may have difficulty determining the sizes of the pieces of the net.

R_x Remind students that the pieces need to be the correct size to fit together (especially the circles on the cylinder, like the diagram in the Example 1 *Assessment For Learning* box).

ELL

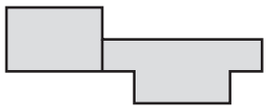
- For #5 in Explore the Math, visually demonstrate what it means to roll an object over.

Answers

Explore the Math

4. No, the nets on the top right and bottom left do not form right rectangular prisms.

5. Answers may vary. For example,



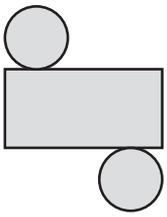
Reflect on Your Findings

6. a) Answers may vary. For example, the number of squares in each net is the same.

b) Yes, there is more than one way to draw a net for a 3-D object; the shape of the net could vary depending on which edges are cut open to draw the net.

Example 1: Show You Know

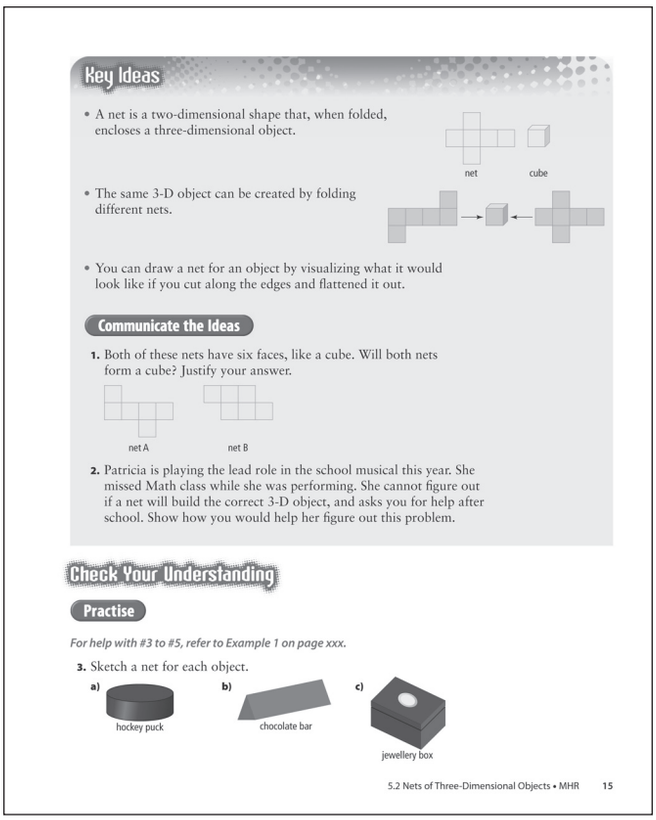
Answers may vary. For example,



Example 2: Show You Know

a square-based rectangular prism

Assessment	Supporting Learning
Assessment *as* Learning	
Reflect on Your Findings Listen as students compare their nets with three other classmates. Try to have students generalize the conclusion about their findings. Students should realize that there is more than one way to draw a net, but they all are made up of the same faces.	• Point out some similarities and differences for students who are having difficulties. • Encourage students to check with more than three classmates if they all have the same net. • Discuss #6b) with the class so students who are struggling may use these responses as a springboard for future questions.
Assessment *for* Learning	
Example 1 Have students do the Show You Know related to Example 1.	• For the Show How You Know, some students may need more than one practice activity. They may benefit from trying to assemble an incorrect net in order to understand how to make a correct net. • Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Provide a can for students to examine. Have them trace the bottom and carefully remove the label to trace for the side. Have students explain why they drew their net the way they did. Clarify any misunderstandings. Clarify that the end (bottom and top) of the can cannot be the same size as the width of the label. Have them compare their tracing to the net drawn.  • You may wish to provide extra practice by choosing other items in the classroom for students to draw.
Example 2 Have students do the Show You Know related to Example 2.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Some students may benefit from tracing the net, cutting it out, and folding it to completion. Have them verbally identify the different parts by name and describe what they would look like from each view. • For enriched students, have them draw a design on the net, and then see how the design fits together as they build it.



Key Ideas

- A net is a two-dimensional shape that, when folded, encloses a three-dimensional object.

net cube

- The same 3-D object can be created by folding different nets.
- You can draw a net for an object by visualizing what it would look like if you cut along the edges and flattened it out.

Communicate the Ideas

1. Both of these nets have six faces, like a cube. Will both nets form a cube? Justify your answer.

net A net B

2. Patricia is playing the lead role in the school musical this year. She missed Math class while she was performing. She cannot figure out if a net will build the correct 3-D object, and asks you for help after school. Show how you would help her figure out this problem.

Check Your Understanding

Practise

For help with #3 to #5, refer to Example 1 on page xxx.

3. Sketch a net for each object.

a) hockey puck b) chocolate bar c) jewellery box

5.2 Nets of Three-Dimensional Objects • MHR 15

Key Ideas

This section reviews how to draw nets and how to use nets to build 3-D objects. Students could draw their own examples from the section to include with the Key Ideas.

Communicate the Ideas

The Communicate the Ideas gives students an opportunity to explain their understanding of nets of 3-D shapes. You may wish to use student responses to this section to see if students understand nets, know how to draw them, and can create the correct 3-D object.

Meeting Student Needs

- For #1 in Communicate the Ideas, some students may need to manipulate the nets to see whether they will form a cube.
- You may wish to provide **BLM 5–9 Section 5.2 Extra Practice** to students who require more practice. You will find the answers to this master on **BLM 5–18 Chapter 5 BLM Answers**.

Common Errors

- Some students might assume that a net will be correct if it has the correct number, size, and shape of faces, even if the placement of the faces is incorrect.

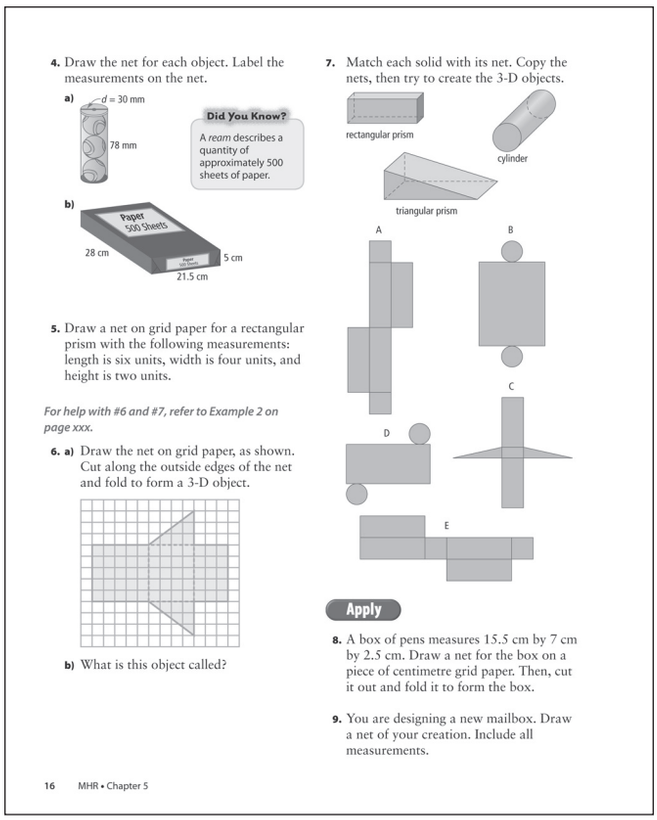
R_x Remind students to use manipulatives if they have difficulty visualizing whether a net is correct.

Answers

Communicate the Ideas

1. No, only net A will fold to form a cube.
2. Answers may vary. For example: trace the net onto paper, cut along the outside edges and fold along the inside edges to figure out if the net forms the correct 3-D object.

Assessment	Supporting Learning
Assessment *as* Learning	
Communicate the Ideas Have all students complete #1.	• Allow students to use graph paper to build the nets for #1. • To ensure understanding, encourage the students to find another net that produces the same cube.



4. Draw the net for each object. Label the measurements on the net.

a) d = 30 mm, 78 mm

Did You Know?

A *ream* describes a quantity of approximately 500 sheets of paper.

b) Paper 500 Sheets, 28 cm, 5 cm, 21.5 cm

5. Draw a net on grid paper for a rectangular prism with the following measurements: length is six units, width is four units, and height is two units.

For help with #6 and #7, refer to Example 2 on page xxx.

6. a) Draw the net on grid paper, as shown. Cut along the outside edges of the net and fold to form a 3-D object.

b) What is this object called?

7. Match each solid with its net. Copy the nets, then try to create the 3-D objects.

rectangular prism, cylinder, triangular prism

A, B, C, D, E

Apply

8. A box of pens measures 15.5 cm by 7 cm by 2.5 cm. Draw a net for the box on a piece of centimetre grid paper. Then, cut it out and fold it to form the box.

9. You are designing a new mailbox. Draw a net of your creation. Include all measurements.

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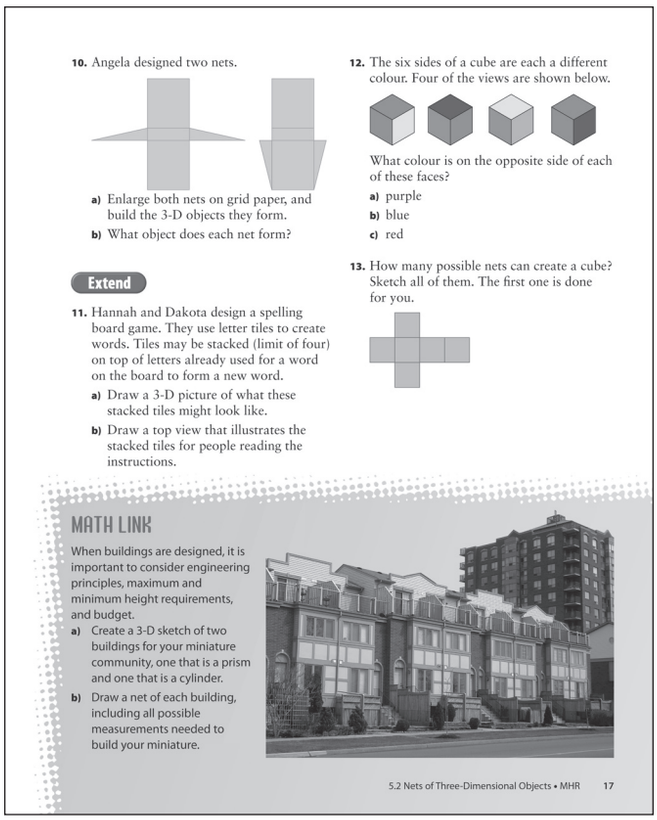


10. Angela designed two nets.

a) Enlarge both nets on grid paper, and build the 3-D objects they form.

b) What object does each net form?

Extend

11. Hannah and Dakota design a spelling board game. They use letter tiles to create words. Tiles may be stacked (limit of four) on top of letters already used for a word on the board to form a new word.

a) Draw a 3-D picture of what these stacked tiles might look like.

b) Draw a top view that illustrates the stacked tiles for people reading the instructions.

12. The six sides of a cube are each a different colour. Four of the views are shown below.

What colour is on the opposite side of each of these faces?

a) purple

b) blue

c) red

13. How many possible nets can create a cube? Sketch all of them. The first one is done for you.

MATH LINK

When buildings are designed, it is important to consider engineering principles, maximum and minimum height requirements, and budget.

a) Create a 3-D sketch of two buildings for your miniature community, one that is a prism and one that is a cylinder.

b) Draw a net of each building, including all possible measurements needed to build your miniature.

5.2 Nets of Three-Dimensional Objects • MHR 17

Check Your Understanding

Practise

Have students work in pairs or small groups to complete the questions in this section. Students should discuss the work and agree on answers. You may want to consider time constraints when assigning specific questions in this section. If students have good spatial awareness, they will find this section easy to complete. However, if students have difficulty with this skill, it will take them time to draw a net, cut it out, and build it. There are several questions asking students to draw nets. If students have no difficulties with this, have them move on to the Apply or Extend questions.

Apply

Provide centimetre grid paper to students for #8 (**Master 8 Centimetre Grid Paper**).

For #9, you may wish to have each student in the class make their own design (connecting to Art class) and then construct it.

For #10, you may need to discuss with students how to enlarge the diagrams. They may find it easiest to use centimetre grid paper and multiply all measurements by 10.

Extend

For #12, encourage students to draw a net and/or construct a cube to help them answer the question.

There are ____ ways to build a net for a cube. Challenge students to discover them all for #13. This is a question that all students can enjoy if they work together in a group. Encourage students to study each other's nets to make sure that they have not produced duplicates.

Math Link

This Math Link is a vital part of the next two Math Links, as well as the Wrap It Up!

You may wish to discuss general considerations of buildings in a community. For example:

- How tall are houses in the same neighbourhood? You normally don't see one house several stories taller than the others.
- What is the approximate height of the houses in the neighbourhood?

Remind students to consider what their building might be used for: residential house, hospital, etc. At this point you might want to incorporate some of your essential buildings discussion from the Chapter Opener.

Meeting Student Needs

- For Practise #7, the differences between the two nets for the cylinder are subtle. Some students may need more practice with constructing nets to catch these subtleties.
- Allow students to work in pairs to complete the Math Link, having each student create one building in cooperation with the other person.
- Give suggestions for measurements if students are having difficulties.
- Making nets for drums will motivate students with a particular interest in music. Check with your local community to see which cultural groups are involved in drum-making and how to approach members of these groups. Also research what special drums may be made and/or owned locally. For example, the Inuit have quite a unique drum design. You may wish to invite someone who is familiar with this to demonstrate it to the class. If possible, have student take measurements of the drums and draw nets for the drum(s).

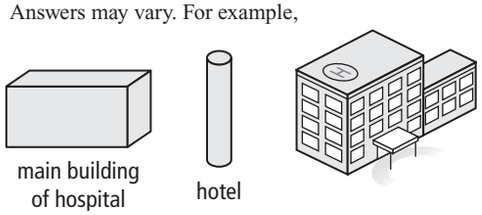
Web Link

Have students research miniature buildings and communities to get ideas for their buildings. For more information about miniature communities, go to www.mathlinks8.ca.

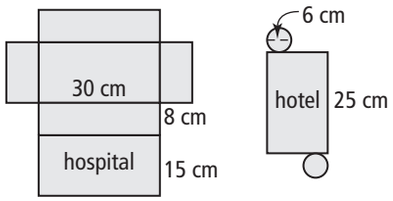
Answers

Math Link

a) Answers may vary. For example,



b)



Assessment	Supporting Learning
Assessment *for* Learning	
Practice Have students do #3 and #7. Students who can readily do these questions can go on to the Apply questions.	• Provide additional coaching to students who need help with drawing nets and building objects. Allowing them to use grid paper would be beneficial. Clarify any misunderstandings and have them do #4. • Students who need assistance with #7 may need to be coached through the first shape a). Have the student explain what the different faces are and how those shapes would look separately. Help the student to link their thinking to a net design given. Have them try #7b) to d) before continuing.
Math Link The Math Link on page xx is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page xx.	• Have students ask a classmate to check over their work to see if they find any mistakes or they can suggest improvements. • Some students may benefit from a class discussion of the typical heights of buildings. • Some students may enjoy doing this with a graphing program, *The Geometer's Sketchpad*®, or other available technology. • **BLM 5–10 Section 5.2 Math Link** provides scaffolding that will help some students complete the Math Link.
Assessment *as* Learning	
Math Learning Log Have students reflect on how well they succeeded in drawing nets and building three-dimensional objects from nets by completing the following statements: –A net and a 3-D object are related because … –The net that I found most difficult to draw was …	• Encourage students to use the What I Need to Work On section of their chapter Foldable to note what they continue to have difficulties with.

5.3 Surface Area of a Prism

***MathLinks 8*, pages xx–xx**

Suggested Timing
80–120 minutes

Materials
- small empty cardboard box
- scissors
- ruler
- scrap paper

Blackline Masters
BLM 5–3 Chapter 5 Warm-Up
BLM 5–10 Section 5.3 Extra Practice
BLM 5–11 Section 5.3 Math Link

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☐ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☑ Reasoning (R)
- ☐ Technology (T)
- ☑ Visualization (V)

Specific Outcomes
SS2 Draw and construct nets for 3-D objects.
SS3 Determine the surface area of:
- right rectangular prisms
- right triangular prisms
- right cylinders

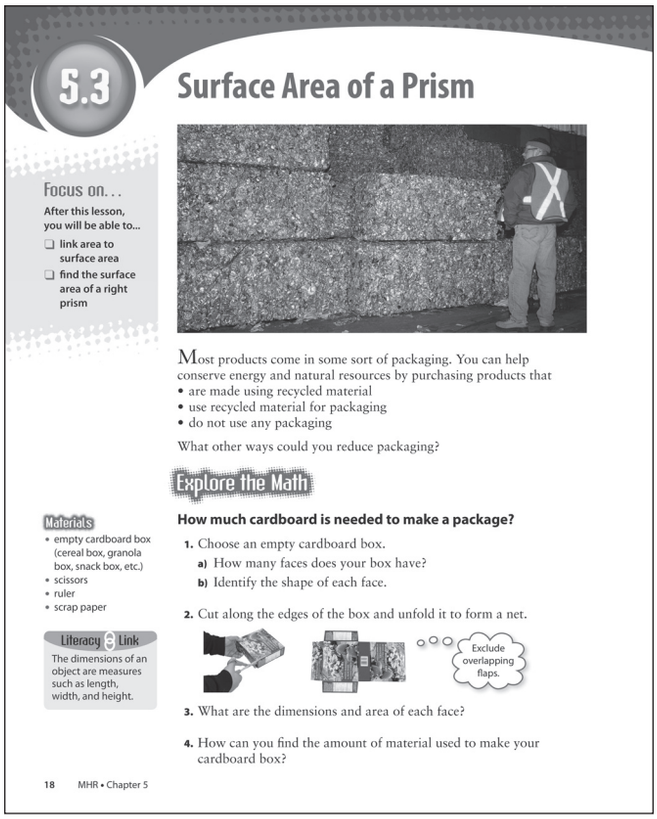
to solve problems.

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1–3, 5, 8, Math Link
Typical	1, 2, 3 or 4, 5 or 6, 8, 10, 12, Math Link
Extension/Enrichment	1, 10–16, Math Link

Planning Notes

Have students complete the warm-up questions on **BLM 5–3 Chapter 5 Warm-Up** to reinforce material learned in previous sections.

Begin this section by having a discussion about recycling and why it is important to recycle packaging. Discuss ways that students could reduce packaging. Ask students to bring in a small empty cardboard box to use for the Explore the Math. Make sure to bring extra boxes for students who forget, or have these students work with a partner.



5.3 Surface Area of a Prism

Focus on...
After this lesson, you will be able to...
- ❑ link area to surface area
- ❑ find the surface area of a right prism

Most products come in some sort of packaging. You can help conserve energy and natural resources by purchasing products that
- are made using recycled material
- use recycled material for packaging
- do not use any packaging

What other ways could you reduce packaging?

Explore the Math

Materials
- empty cardboard box (cereal box, granola box, snack box, etc.)
- scissors
- ruler
- scrap paper

Literacy Link
The dimensions of an object are measures such as length, width, and height.

How much cardboard is needed to make a package?

1. Choose an empty cardboard box.
   a) How many faces does your box have?
   b) Identify the shape of each face.
2. Cut along the edges of the box and unfold it to form a net.

Exclude overlapping flaps.

3. What are the dimensions and area of each face?
4. How can you find the amount of material used to make your cardboard box?

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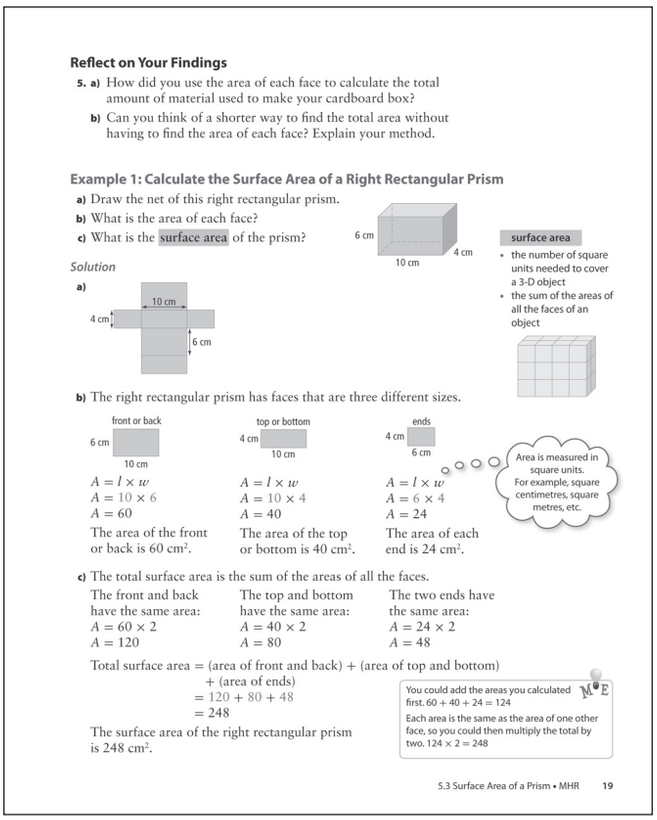
Explore the Math

Have all students participate in this activity. You may wish to have an example made up prior to class to show to students. Before students do #4, have a class discussion about dimensions and how to find the area from the Literacy Link to help students who have forgotten how to do the calculations.

Example 1

Before beginning Example 1, ask students what surface area means. Discuss the definition in the textbook. Discuss ways find the amount of cardboard needed for the boxes without cutting up the boxes. Remind students that area is measured in square units.



Reflect on Your Findings

5. a) How did you use the area of each face to calculate the total amount of material used to make your cardboard box?

b) Can you think of a shorter way to find the total area without having to find the area of each face? Explain your method.

Example 1: Calculate the Surface Area of a Right Rectangular Prism

a) Draw the net of this right rectangular prism.

b) What is the area of each face?

c) What is the surface area of the prism?

6 cm, 4 cm, 10 cm

surface area
- the number of square units needed to cover a 3-D object
- the sum of the areas of all the faces of an object

Solution

a)

10 cm, 4 cm, 6 cm

b) The right rectangular prism has faces that are three different sizes.

front or back: 6 cm, 10 cm
$A = l \times w$
$A = 10 \times 6$
$A = 60$
The area of the front or back is 60 cm².

top or bottom: 4 cm, 10 cm
$A = l \times w$
$A = 10 \times 4$
$A = 40$
The area of the top or bottom is 40 cm².

ends: 4 cm, 6 cm
$A = l \times w$
$A = 6 \times 4$
$A = 24$
The area of each end is 24 cm².

Area is measured in square units. For example, square centimetres, square metres, etc.

c) The total surface area is the sum of the areas of all the faces.

The front and back have the same area:
$A = 60 \times 2$
$A = 120$

The top and bottom have the same area:
$A = 40 \times 2$
$A = 80$

The two ends have the same area:
$A = 24 \times 2$
$A = 48$

Total surface area = (area of front and back) + (area of top and bottom) + (area of ends)
$= 120 + 80 + 48$
$= 248$

The surface area of the right rectangular prism is 248 cm².

ME: You could add the areas you calculated first. 60 + 40 + 24 = 124. Each area is the same as the area of one other face, so you could then multiply the total by two. 124 × 2 = 248

5.3 Surface Area of a Prism • MHR 19

Show You Know

What is the surface area of this right rectangular prism?

16 cm, 8 cm, 3 cm

Example 2: Calculate the Surface Area of a Right Triangular Prism

a) Draw the net of this right triangular prism.

b) What is the area of each face?

c) What is the total surface area?

9 m, 3 m, 2.6 m

Solution

a)

9 m, 3 m, 2.6 m

Strategies
Draw a Diagram
Refer to page xxx.

Literacy Link
An equilateral triangle has three equal sides and three equal angles. Equal sides are shown on diagrams by placing tick marks on them.

b) The bases of the prism are equilateral triangles. The sides of the prism are rectangles.

rectangle: 3 m, 9 m
$A = l \times w$
$A = 9 \times 3$
$A = 27$
The area of one rectangle is 27 m².

triangle: 2.6 m, 3 m
$A = (b \times h) \div 2$
$A = (3 \times 2.6) \div 2$
$A = 7.8 \div 2$
$A = 3.9$
The area of one triangle is 3.9 m².

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Example 2

Remind students how to find the area of a triangle. Have students work through the example trying to find a more efficient way to find the total. Point out to students that not all triangular prisms have equilateral triangles. They need to watch for different side lengths of the triangle, which will affect the dimensions of the rectangles.

Meeting Student Needs

- Before beginning this section, review finding the area of squares, rectangles, and triangles.
- Remind students to work through each part if they are making careless mistakes. Some may miss some of the information.
- Students may need to calculate the area of each face instead of doubling or adding it twice.
- Create a poster for the classroom showing the nets of a rectangular prism and a triangular prism. In each net, write the steps for finding the surface area of each form.
- Have students think of objects that are special to them or their culture that are prisms, such as parfleche-style containers, feather boxes, hope chests, birch bark boxes, and cedar boxes.

Common Errors

- Students may forget to include the area of one or more faces in the total.

R_x Remind students that surface area means the total of the areas of all the faces.

- Students may assume that all triangular prisms have an equilateral triangle as their base.

R_x Remind students not to assume their triangular prism has an equilateral triangle.

- Some students may use incorrect area formulas.

R_x Ensure student use the correct area formulas for each of the shapes.

ELL

- Students might have difficulty with the following vocabulary: packaging, conserve energy, natural resources, purchasing, unfold, dimensions, equilateral, set of guidelines, bike ramp, wrapping paper, cake pan, and least amount. Review the definitions of these words.
- Very new English language learners should not complete the Reflect on Your Finding unless there is another student who speaks the same language and can translate the questions for them. Ensure understanding of these questions by either pairing students or orally explaining the questions with the whole class.

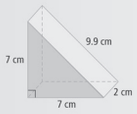
c) You must add the areas of all faces to find the surface area.
This right triangular prism has five faces.
There are three rectangles of the same size and two triangles of the same size.

Total surface area = (3 × area of rectangle) + (2 × area of triangle)
= (3 × 27) + (2 × 3.9)
= 81 + 7.8
= 88.8

The surface area of the right triangular prism is 88.8 m².

Show You Know

Find the surface area of this triangular prism.



Key Ideas

- Surface area is the sum of the areas of all the faces of a 3-D object.

Surface Area = A1 + A2 + A3 + A4 + A5 + A6, where A1 represents the area of rectangle 1, A2 represents the area of rectangle 2, etc.

Communicate the Ideas

1. Write a set of guidelines that you could use to find the surface area of a prism. Share your guidelines with a classmate.
2. A right rectangular prism has six faces. Why do you have to find the area of only three of the faces to be able to find the surface area. Use pictures and words to explain your thinking.

5.3 Surface Area of a Prism • MHR 21

Answers

Explore the Math

1. a) 6 **b)** rectangle

3. Answers may vary. For example, consider a cardboard box with length 20 cm, width 10 cm, and height 4 cm. There are two faces, each measuring 20 cm by 10 cm, with an area of 200 cm^2. There are another two faces, each measuring 20 cm by 4 cm, with an area of 80 cm^2. The two remaining faces, each measuring 10 cm by 4 cm, have an area of 40 cm^2.

4. Answers may vary. For example, add the areas of the six rectangular faces in the net.

Reflect on Your Findings

5. a) Answers may vary. For example, find the sum of the areas of the six faces.

b) Answers may vary. For example, since there are three pairs of equal faces, add the areas of the three different faces, and double the sum to find the total area.

Example 1: Show You Know

400 cm^2

Example 2: Show You Know

96.8 cm^2

Assessment	Supporting Learning
Assessment *as* Learning	
Reflect on Your Findings Listen as students discuss what they discovered during the Explore the Math. Try to have students generalize a conclusion from their findings. These questions are intended to help students to discover that the sum of the areas of each face equals the surface area, and identify a strategy to find surface area.	• If students are having difficulty, consider working through an example using a 3-D object that you cut apart and manipulate. Alternatively, consider pairing students so they can explain their thinking to each other. • Discussing the response to #6b) as a class may benefit those students experiencing difficulty and allow them to use the discussion as a springboard to understanding for questions that follow.
Assessment *for* Learning	
Example 1 Have students do the Show You Know related to Example 1.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Encourage students to show all their work, so you can identify any mistakes. • If students need additional practice, they can measure any rectangular prism in the classroom (e.g., the top of a desk) and calculate its surface area.
Example 2 Have students do the Show You Know related to Example 2.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Notice that this is an isosceles triangle, which is different than the triangle shown in the example. • Drawing a net and labeling the dimensions may benefit some students, while others may find it more confusing. • Having students identify the different shapes individually and the measurements of their sides may make it easier for them to calculate the area of each face separately and add their answers together. • Encourage students to check their answers with a classmate to help clarify their understanding or catch anything that is missing.

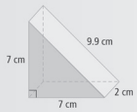
c) You must add the areas of all faces to find the surface area.
This right triangular prism has five faces.
There are three rectangles of the same size and two triangles of the same size.

Total surface area = (3 × area of rectangle) + (2 × area of triangle)
= (3 × 27) + (2 × 3.9)
= 81 + 7.8
= 88.8

The surface area of the right triangular prism is 88.8 m².

Show You Know

Find the surface area of this triangular prism.



Key Ideas

- Surface area is the sum of the areas of all the faces of a 3-D object.

Surface Area = A1 + A2 + A3 + A4 + A5 + A6, where A1 represents the area of rectangle 1, A2 represents the area of rectangle 2, etc.

Communicate the Ideas

1. Write a set of guidelines that you could use to find the surface area of a prism. Share your guidelines with a classmate.
2. A right rectangular prism has six faces. Why do you have to find the area of only three of the faces to be able to find the surface area. Use pictures and words to explain your thinking.

5.3 Surface Area of a Prism • MHR 21

Key Ideas

Have students relate the Key Ideas to the Communicate the Ideas. For example, have students examine the guidelines in the Key Ideas before writing the set of guidelines for #2 in Communicate the Ideas. In addition, you may wish to have students rewrite the Key Ideas in their own words and include a worked example of their own.

Communicate the Ideas

The Communicate the Ideas gives students an opportunity to explain their understanding of how to calculate surface area.

Meeting Student Needs

- Some students may benefit from group discussions prior to writing down their own ideas.
- You may wish to provide **BLM 5–11 Section 5.3 Extra Practice** to students who require more practice. You will find the answers to this master on **BLM 5–18 Chapter 5 BLM** answers.

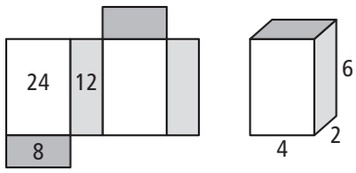
ELL

- Give students who are English language learners a simple model of a set of guidelines. An example of such a model set might be "Come into class after recess. You must come in quietly. Put away jackets and be seated. Have a pen, your notebook, and your textbook, and sit quietly."
- Allow students to write their guidelines in different languages.

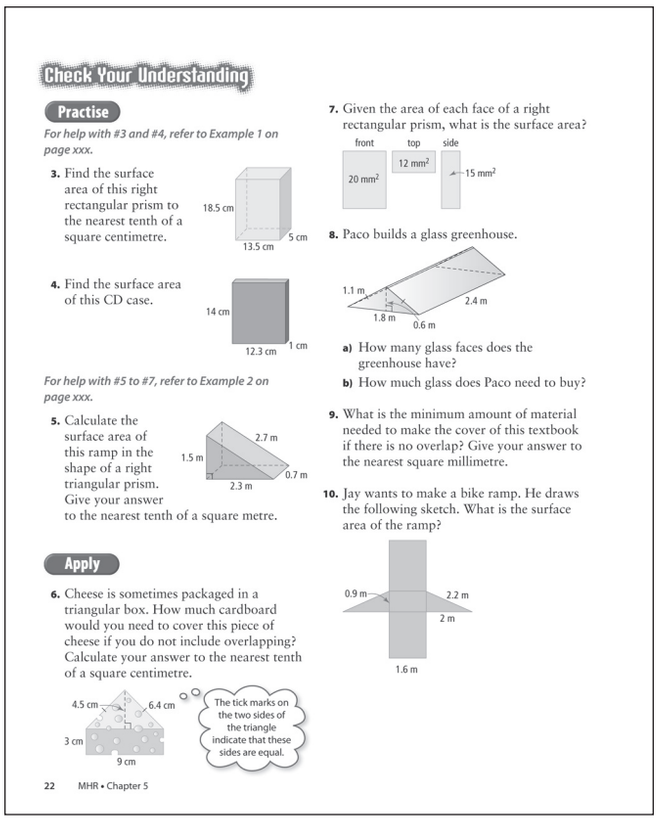
Answers

Communicate the Ideas

1. Answers may vary. For example,
   - Draw a net for the prism.
   - Find the area of each face.
   - Find the sum of the areas of all the faces.
2. Answers may vary. For example:
   In a right rectangular prism, the opposite faces are the same. When you know the total area of the three faces of different sizes, you can double the result to find the surface area of the prism. The net of this rectangular prism shows that the sum of the three faces on the left is 44 square units. The surface area of the prism is double that of 44 square units, or 88 square units.



Assessment	Supporting Learning
Assessment *as* Learning	
Communicate the Ideas Have all students complete #1 and #2.	• Encourage students who need to do so to share their ideas orally before recording them. • Invite students to discuss possible pictures of prisms to describe for their answers. • Encourage students to draw a sketch for #2.



Check Your Understanding

Practise

For help with #3 and #4, refer to Example 1 on page xxx.

3. Find the surface area of this right rectangular prism to the nearest tenth of a square centimetre.

18.5 cm, 13.5 cm, 5 cm

4. Find the surface area of this CD case.

14 cm, 12.3 cm, 1 cm

For help with #5 to #7, refer to Example 2 on page xxx.

5. Calculate the surface area of this ramp in the shape of a right triangular prism. Give your answer to the nearest tenth of a square metre.

1.5 m, 2.7 m, 2.3 m, 0.7 m

Apply

6. Cheese is sometimes packaged in a triangular box. How much cardboard would you need to cover this piece of cheese if you do not include overlapping? Calculate your answer to the nearest tenth of a square centimetre.

4.5 cm, 6.4 cm, 3 cm, 9 cm

The tick marks on the two sides of the triangle indicate that these sides are equal.

7. Given the area of each face of a right rectangular prism, what is the surface area?

front, top, side; 20 mm², 12 mm², 15 mm²

8. Paco builds a glass greenhouse.

1.1 m, 1.8 m, 0.6 m, 2.4 m

a) How many glass faces does the greenhouse have?

b) How much glass does Paco need to buy?

9. What is the minimum amount of material needed to make the cover of this textbook if there is no overlap? Give your answer to the nearest square millimetre.

10. Jay wants to make a bike ramp. He draws the following sketch. What is the surface area of the ramp?

0.9 m, 2.2 m, 2 m, 1.6 m

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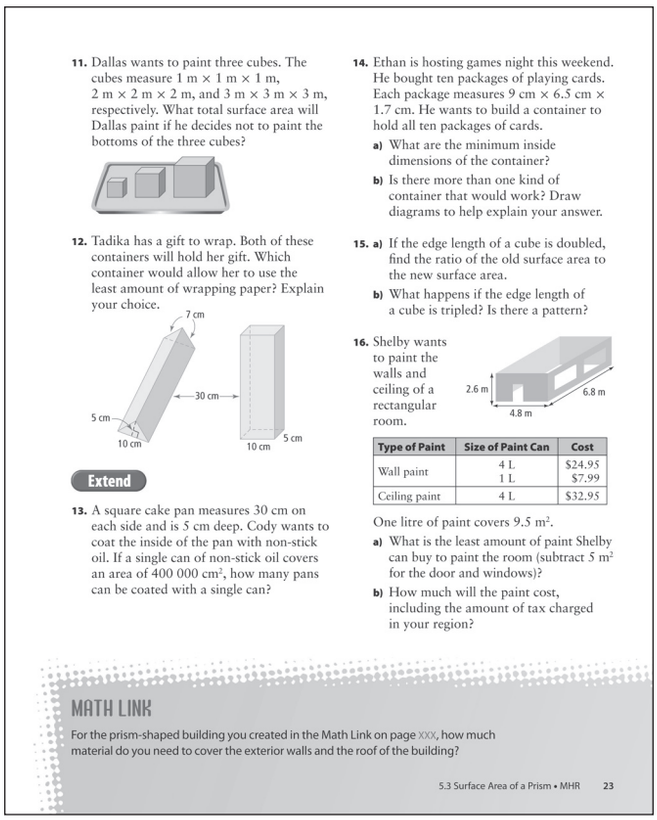


11. Dallas wants to paint three cubes. The cubes measure 1 m × 1 m × 1 m, 2 m × 2 m × 2 m, and 3 m × 3 m × 3 m, respectively. What total surface area will Dallas paint if he decides not to paint the bottoms of the three cubes?

12. Tadika has a gift to wrap. Both of these containers will hold her gift. Which container would allow her to use the least amount of wrapping paper? Explain your choice.

7 cm, 5 cm, 30 cm, 10 cm, 10 cm, 5 cm

Extend

13. A square cake pan measures 30 cm on each side and is 5 cm deep. Cody wants to coat the inside of the pan with non-stick oil. If a single can of non-stick oil covers an area of 400 000 cm², how many pans can be coated with a single can?

14. Ethan is hosting games night this weekend. He bought ten packages of playing cards. Each package measures 9 cm × 6.5 cm × 1.7 cm. He wants to build a container to hold all ten packages of cards.

a) What are the minimum inside dimensions of the container?

b) Is there more than one kind of container that would work? Draw diagrams to help explain your answer.

15. **a)** If the edge length of a cube is doubled, find the ratio of the old surface area to the new surface area.

b) What happens if the edge length of a cube is tripled? Is there a pattern?

16. Shelby wants to paint the walls and ceiling of a rectangular room.

2.6 m, 4.8 m, 6.8 m

Type of Paint	Size of Paint Can	Cost
Wall paint	4 L	$24.95
	1 L	$7.99
Ceiling paint	4 L	$32.95

One litre of paint covers 9.5 m².

a) What is the least amount of paint Shelby can buy to paint the room (subtract 5 m² for the door and windows)?

b) How much will the paint cost, including the amount of tax charged in your region?

MATH LINK

For the prism-shaped building you created in the Math Link on page xxx, how much material do you need to cover the exterior walls and the roof of the building?

5.3 Surface Area of a Prism • MHR 23

Check Your Understanding

Practise

Review rounding off to the tenth and hundredth decimal place with the entire class prior to assigning questions to students. This part of the lesson has only four questions because each one asks students to find the surface area, which involves many calculations. You may wish to have students do #3 or #4 and #5 or #6 so that they are doing questions that cover both rectangular and triangular prisms.

Apply

The Apply questions require students to find surface area. Question 7 is a basic question in which students work with the area of each face, but have to consider how many faces there are.

Question 8, which is similar to #5 and #6, is an example of a real-world application. It has a progressive approach, therefore students who are still having difficulty will be prompted by the question, through each step of solving the problem.

When working on #10, you may wish to refer students back to the two nets they enlarged in #10 on page xx in Section 5.2.

For #12, have students consider the amount of wrapping paper used, without considering the amount of waste.

Extend

The Extend questions invite students to apply their knowledge of surface area to solving problems involving surface area.

Several questions in this section include job-related skills. You may wish to discuss how designers, chefs, and interior decorators use surface area.

Math Link

This Math Link requires students to use the building they created in the Math Link from Section 5.2. If students missed that lesson, have them do parts a) and b) for the prism in order to complete this Math Link.

Meeting Student Needs

- Have students who missed the last Math Link work with a partner to complete this section. This will decrease the number of buildings to choose from when the class is ready to complete the Wrap It Up! at the end of this chapter.
- For #8, some students may not be familiar with tree houses. You may wish to provide a photo of one.

Answers

Math Link

Answers may vary. For example, a miniature hospital building in the shape of a right rectangular prism that is 30 cm wide, 8 cm deep, and 15 cm tall, would need 1380 cm^2 of material.

Assessment	Supporting Learning
Assessment *for* Learning	
Practise Have students do #3 and #5. Students who can readily answer these questions can go on to the Apply questions.	• Refer students who need help with #3 back to Example 1. They may also find it easier to sketch out three of the faces, find the areas of each and add them together. These students should be asked how they could use the work they have done to find the surface area and how they could generalize the process. Have students try #4 before proceeding. • Provide additional coaching in Example 2 to students who need help with #5. Coach them through this question and have them try #6 on their own.
Math Link The Math Link on page xx is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page xx.	• Clarify that the building will have sides and the roof will be covered, as the floor is not on the outside, but in the ground. • Encourage students to check each other's work for errors. • **BLM 5–12 Section 5.3 Math Link** provides scaffolding that will help some students complete the Math Link.
Assessment *as* Learning	
Math Learning Log Have students answer the following question: –Explain the similarities and differences between the processes of finding the surface area of a rectangular prism and a triangular prism.	• Students may benefit from a class discussion about the steps they need to take to find the surface area of each object. • Consider recording the steps on chart paper. Then, have students use the notes to identify the similarities and differences between the two processes. • Encourage students to use the What I Need to Work On section of their chapter Foldable to note what they continue to have difficulties with.

5.4 Surface Area of a Cylinder

***MathLinks 8*, pages xx–xx**

Suggested Timing
80–120 minutes

Materials
- glow stick or other cylindrical object (optional)
- grid paper
- ruler

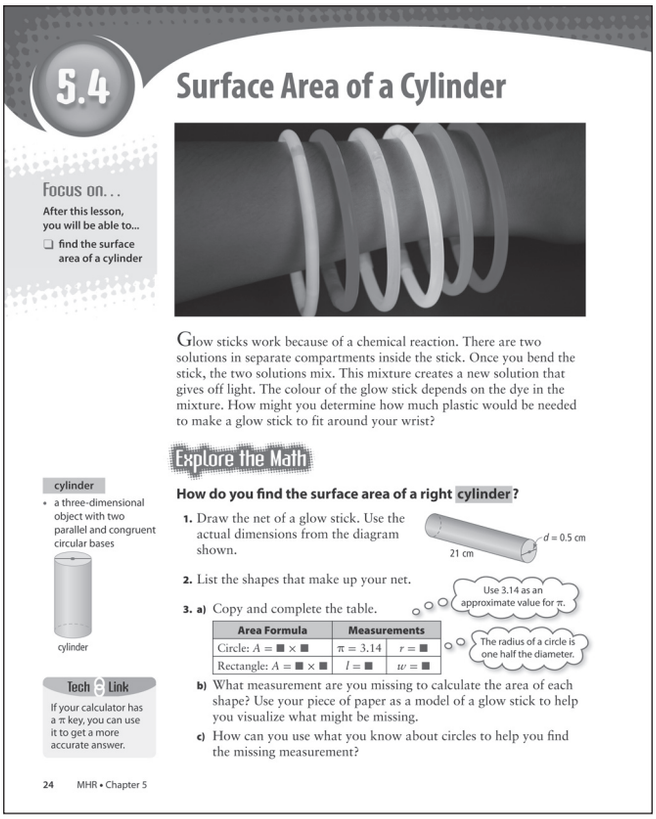
Blackline Masters
Master 8 Centimetre Grid Paper
BLM 5–13 Compare the Surface Area of a Prism and a Cylinder
BLM 5–14 Section 5.4 Extra Practice
BLM 5–15 Section 5.4 Math Link

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☑ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☑ Reasoning (R)
- ☐ Technology (T)
- ☑ Visualization (V)

Specific Outcomes
SS2 Draw and construct nets for 3-D objects.
SS3 Determine the surface area of:
- right rectangular prisms
- right triangular prisms
- right cylinders

to solve problems.

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1–4, 6, 8, Math Link
Typical	1–3, 4 or 5, 6, 8–10, Math Link
Extension/Enrichment	2, 6a) or b), 9, 11–13, Math Link



5.4 Surface Area of a Cylinder

Focus on...
After this lesson, you will be able to...
❑ find the surface area of a cylinder

Glow sticks work because of a chemical reaction. There are two solutions in separate compartments inside the stick. Once you bend the stick, the two solutions mix. This mixture creates a new solution that gives off light. The colour of the glow stick depends on the dye in the mixture. How might you determine how much plastic would be needed to make a glow stick to fit around your wrist?

Explore the Math

cylinder
- a three-dimensional object with two parallel and congruent circular bases

cylinder

Tech Link
If your calculator has a π key, you can use it to get a more accurate answer.

How do you find the surface area of a right cylinder?

1. Draw the net of a glow stick. Use the actual dimensions from the diagram shown.

21 cm, d = 0.5 cm

2. List the shapes that make up your net.
3. a) Copy and complete the table.

Use 3.14 as an approximate value for π.

Area Formula	Measurements	
Circle: $A = \blacksquare \times \blacksquare$	$\pi = 3.14$	$r = \blacksquare$
Rectangle: $A = \blacksquare \times \blacksquare$	$l = \blacksquare$	$w = \blacksquare$

The radius of a circle is one half the diameter.

b) What measurement are you missing to calculate the area of each shape? Use your piece of paper as a model of a glow stick to help you visualize what might be missing.
c) How can you use what you know about circles to help you find the missing measurement?

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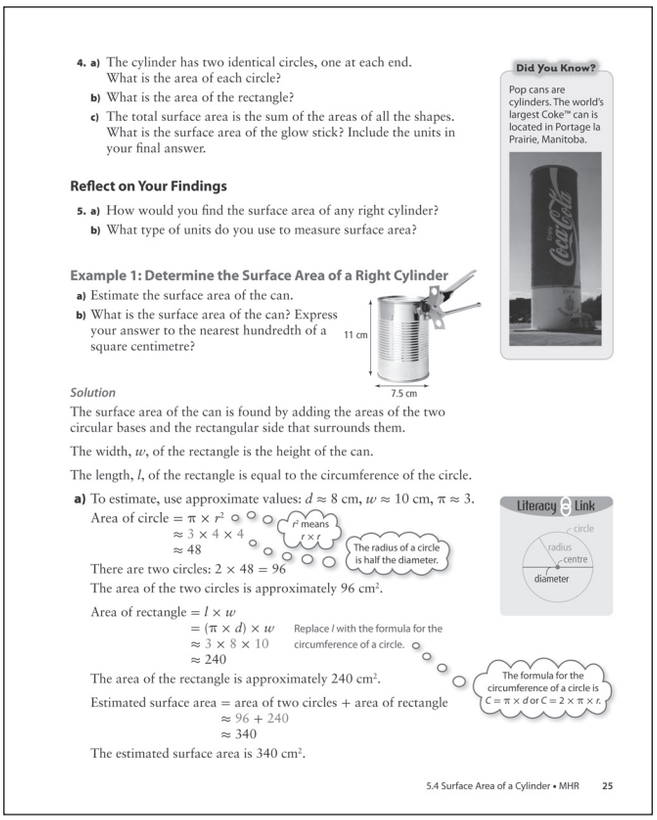
Planning Notes

Have students complete the warm up questions on **BLM 5–3 Chapter 5 Warm-Up** to reinforce material learned in previous sections.

You may wish to bring in a glow stick to show any students who have not seen one. Students could then measure the actual glow stick for more accurate dimensions or for a comparison.

Explore the Math

Students will benefit from recalling how they found the surface area of a prism in the previous section. Distribute **Master 8 Centimetre Grid Paper**. Have students work in partners or small groups for this activity. The activity is mostly self-guided; however, students must figure out that the missing dimension of the rectangle is found by calculating the circumference of the circle.



4. a) The cylinder has two identical circles, one at each end. What is the area of each circle?
b) What is the area of the rectangle?
c) The total surface area is the sum of the areas of all the shapes. What is the surface area of the glow stick? Include the units in your final answer.

Reflect on Your Findings

5. a) How would you find the surface area of any right cylinder?
b) What type of units do you use to measure surface area?

Example 1: Determine the Surface Area of a Right Cylinder

a) Estimate the surface area of the can.
b) What is the surface area of the can? Express your answer to the nearest hundredth of a square centimetre?

11 cm
7.5 cm

Solution

The surface area of the can is found by adding the areas of the two circular bases and the rectangular side that surrounds them.

The width, w, of the rectangle is the height of the can.

The length, l, of the rectangle is equal to the circumference of the circle.

a) To estimate, use approximate values: $d \approx 8$ cm, $w \approx 10$ cm, $\pi \approx 3$.

Area of circle $= \pi \times r^2$
$\approx 3 \times 4 \times 4$ (r means r × r)
≈ 48 (The radius of a circle is half the diameter.)

There are two circles: $2 \times 48 = 96$

The area of the two circles is approximately 96 cm^2.

Area of rectangle $= l \times w$
$= (\pi \times d) \times w$ Replace l with the formula for the circumference of a circle.
$\approx 3 \times 8 \times 10$
≈ 240

The area of the rectangle is approximately 240 cm^2.

Estimated surface area = area of two circles + area of rectangle
$\approx 96 + 240$
≈ 340

The estimated surface area is 340 cm^2.

Did You Know?

Pop cans are cylinders. The world's largest Coke™ can is located in Portage la Prairie, Manitoba.

Literacy Link

The formula for the circumference of a circle is $C = \pi \times d$ or $C = 2 \times \pi \times r$.

5.4 Surface Area of a Cylinder • MHR 25

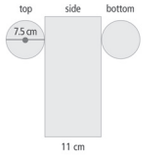
Strategies

Draw a Diagram

Refer to page xxx.

b) *Method 1: Use a Net*

Draw the net and label the measurements.



The diameter of the circle is 7.5 cm.
Determine the radius.
$7.5 \div 2 = 3.75$
The radius of the circle is 3.75 cm.

Find the area of one circle.
$A = \pi \times r^2$
$A \approx 3.14 \times 3.75^2$ (Use 3.14 as an approximate value for π.)
$A \approx 44.15625$
The area of one circle is approximately 44.15625 cm^2.

Find the area of two circles.
$2 \times 44.15625 = 88.3125$
The area of both circles is approximately 88.3125 cm^2.

Find the area of the rectangle using the circumference of the circle.
$A = l \times w$
$A = (\pi \times d) \times w$ Replace l with the formula for the circumference of a circle.
$A \approx 3.14 \times 7.5 \times 11$
$A \approx 259.05$
The area of the rectangle is approximately 259.05 cm^2.

Calculate the total surface area.
Total surface area = 88.3125 + 259.05
= 347.3625

(Round your answer at the end of the calculation.) The total surface area is approximately 347.36 cm^2.

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Example 1

This example demonstrates two strategies for determining the surface area of a cylinder. Method 1 uses a strategy similar to that seen in Section 5.3, where students find the area of each face and add them all together. Method 2 uses a formula to find the surface area.

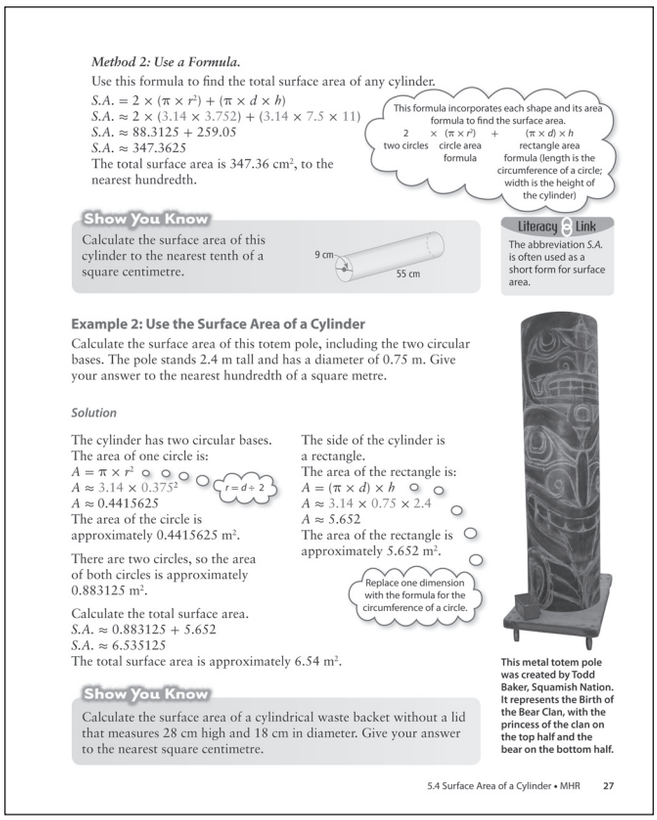
You may wish to do a hands-on demonstration to clarify where and why circumference is used, so that students can see how the rectangle edge is equivalent to the circumference of the circle. Remind students that the symbol ≈ means an approximate answer due to an estimation or because 3.14 is a rounded off value of pi.

Example 2

Example 2 demonstrates how a strategy using surface area can apply to a real-life context. Remind students how to find the area of a circle.

Meeting Student Needs

- Before beginning this section, review how to find the area of a circle.
- Provide nets for students to cut out and manipulate if needed.
- Encourage students to draw a net and label the dimensions for clarification.
- Create a poster for the classroom showing the net for a cylinder. In the net, write the steps for finding the surface area.
- Before working on the Show You Know question for Example 1, provide students with additional practice. Work as a whole class and measure a can. Demonstrate rounding each measurement to the nearest whole number. Use the measurements to calculate the surface area of the can. Use both methods (making a net and using an equation) to calculate surface area. Have the students work as partners to repeat the activity several times with different-sized cans or other cylindrical items As an alternative to cans, groups could use a hand drum or drum used at powwows. Have the students work in small groups and discuss how they would come up with pattern or net to teach others how to make a drum.



Method 2: Use a Formula.

Use this formula to find the total surface area of any cylinder.

$S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$
$S.A. \approx 2 \times (3.14 \times 3.752) + (3.14 \times 7.5 \times 11)$
$S.A. \approx 88.3125 + 259.05$
$S.A. \approx 347.3625$
The total surface area is 347.36 cm², to the nearest hundredth.

This formula incorporates each shape and its area formula to find the surface area.
2 (two circles) × (π × r²) (circle area formula) + (π × d) × h (rectangle area formula (length is the circumference of a circle; width is the height of the cylinder))

Show You Know

Calculate the surface area of this cylinder to the nearest tenth of a square centimetre.

9 cm
55 cm

Literacy Link

The abbreviation *S.A.* is often used as a short form for surface area.

Example 2: Use the Surface Area of a Cylinder

Calculate the surface area of this totem pole, including the two circular bases. The pole stands 2.4 m tall and has a diameter of 0.75 m. Give your answer to the nearest hundredth of a square metre.

Solution

The cylinder has two circular bases.
The area of one circle is:
$A = \pi \times r^2$
$A \approx 3.14 \times 0.375^2$ ($r = d \div 2$)
$A \approx 0.4415625$
The area of the circle is approximately 0.4415625 m².

There are two circles, so the area of both circles is approximately 0.883125 m².

Calculate the total surface area.
$S.A. \approx 0.883125 + 5.652$
$S.A. \approx 6.535125$
The total surface area is approximately 6.54 m².

The side of the cylinder is a rectangle.
The area of the rectangle is:
$A = (\pi \times d) \times h$
$A \approx 3.14 \times 0.75 \times 2.4$
$A \approx 5.652$
The area of the rectangle is approximately 5.652 m².

Replace one dimension with the formula for the circumference of a circle.

This metal totem pole was created by Todd Baker, Squamish Nation. It represents the Birth of the Bear Clan, with the princess of the clan on the top half and the bear on the bottom half.

Show You Know

Calculate the surface area of a cylindrical waste backet without a lid that measures 28 cm high and 18 cm in diameter. Give your answer to the nearest square centimetre.

5.4 Surface Area of a Cylinder • MHR 27

Common Errors

- Some students might include the area of only one circle in their total.

R$_x$ Remind students to add the areas of all shapes in their total.

- Some students may not follow the order of operations when calculating the area of a circle.

R$_x$ Ensure students square the radius before multiplying by pi.

- Some students may use the diameter instead of the radius to try to calculate the area of a circle.

R$_x$ Review the formula for calculating the area of a circle.

ELL

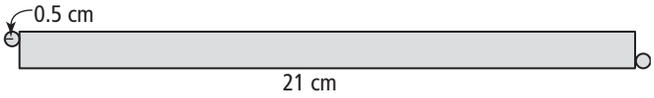
- Students may have difficulty with the following vocabulary: glow sticks, chemical reaction, separate compartments, identical, surrounds, re-cover, stool, overlap, tube, container, coins, plastic wrapper, and paint roller.

- As the students are introduced to the investigation, use the picture and/or a real glow stick to ensure that the students fully understand what a glow stick is. You may wish to do a quick drawing on the chalkboard of what the inside of a glow stick might look like with two different compartments and how when bent they break and mix.
- Ensure that English language learners understand that the convention of a box in a math question usually means to find the missing number.

Answers

Explore the Math

1. Answers may vary. For example,



2. two circles and a rectangle

3. a)

Area Formula	Measurements	
Circle: $A = \pi \times r^2$	$\pi = 3.14$	$r = 0.25$ cm
Rectangle: $A = l \times w$	$l = 21$ cm	$w = 1.57$ cm

b) the width of the rectangle

c) The width w of the rectangle is equal to the circumference C of the circle. For a circle, $C = \pi \times d$, where d is the diameter. So, $w = 3.14 \times 0.5 = 1.57$.

4. a) 0.20 cm² **b)** 32.97 cm² **c)** 33.37 cm²

Reflect on Your Findings

5. a) The area of a cylinder is the sum of the areas of the two circles and the rectangle in its net.

b) square units

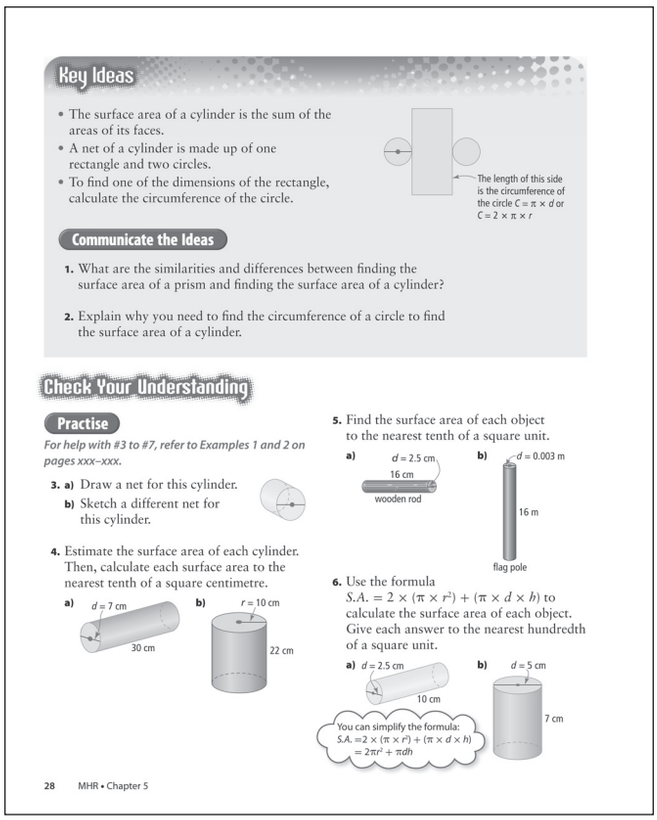
Example 1: Show You Know

1681.5 cm²

Example 2: Show You Know

1837 cm²

Assessment	Supporting Learning
Assessment *as* Learning	
Reflect on Your Findings Listen as students discuss what they discovered during the Explore the Math. Try to have students generalize a conclusion from their findings. A critical point for students is to use the circumference formula when calculating the area of the rectangle to get the total surface area.	• Have students try to find alternatives to using the circumference formula if you give them the answer for the surface area of the cylinder, and encourage them to work backwards from the answer. (There aren't any alternatives. Students may make fewer mistakes or be less likely to forget to use the circumference formula if they exhaust all other possibilities.) • Some students may benefit from having the surface area formula for the cylinder written using only radius so they don't have two different values (d and r) in the formula. $SA = 2\pi r + 2\pi r^2 h$ • Discussing the answer may assist those students who can use the thinking to apply to future questions.
Assessment *for* Learning	
Example 1 Have students do the Show You Know related to Example 1.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Encourage students to estimate their answers first so as to help them determine whether the actual answer is reasonable. • Encourage students to use any strategy they prefer.
Example 2 Have students do the Show You Know related to Example 2.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Encourage students who are struggling to draw a diagram and label it with the given dimensions. • Have students try to use the strategy they didn't choose for the Show You Know after Example 1. • Consider having students check each other's answer.



Key Ideas

- The surface area of a cylinder is the sum of the areas of its faces.
- A net of a cylinder is made up of one rectangle and two circles.
- To find one of the dimensions of the rectangle, calculate the circumference of the circle.

The length of this side is the circumference of the circle $C = \pi \times d$ or $C = 2 \times \pi \times r$

Communicate the Ideas

1. What are the similarities and differences between finding the surface area of a prism and finding the surface area of a cylinder?
2. Explain why you need to find the circumference of a circle to find the surface area of a cylinder.

Check Your Understanding

Practise

For help with #3 to #7, refer to Examples 1 and 2 on pages xxx–xxx.

3. a) Draw a net for this cylinder.
   b) Sketch a different net for this cylinder.
4. Estimate the surface area of each cylinder. Then, calculate each surface area to the nearest tenth of a square centimetre.
   a) $d = 7$ cm, 30 cm
   b) $r = 10$ cm, 22 cm
5. Find the surface area of each object to the nearest tenth of a square unit.
   a) $d = 2.5$ cm, 16 cm, wooden rod
   b) $d = 0.003$ m, 16 m, flag pole
6. Use the formula $S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$ to calculate the surface area of each object. Give each answer to the nearest hundredth of a square unit.
   a) $d = 2.5$ cm, 10 cm
   b) $d = 5$ cm, 7 cm

You can simplify the formula: $S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h) = 2\pi r^2 + \pi dh$

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Key Ideas

Have students summarize the Key Ideas section in their own words, using different diagrams and a worked example using the method they prefer.

Communicate the Ideas

You may wish to have students work with a partner to discuss their answers and present them to the class. Record all similarities and differences on chart paper for students to refer to throughout this section.

Literacy Link Identifying similarities and differences has proven to be one of the most effective strategies for learning. Developing a comparison using a graphic organizer, such as a double bubble organizer, provides students with a visual and memory aid. You may wish to put the double bubble organizer on **BLM 5–13 Compare the Surface Area of a Prism** and a Cylinder on an overhead transparency and fill in the blanks with students.

Meeting Student Needs

- Have students work in groups of three or four to answer the Communicate the Ideas section.
- Have groups hand in their answers instead of reporting in front of the entire class.
- Double bubble organizers are particularly useful for visual learners. You may wish to have these students fill out **BLM 5–13 Compare the Surface Area of a Prism and a Cylinder** on their own.

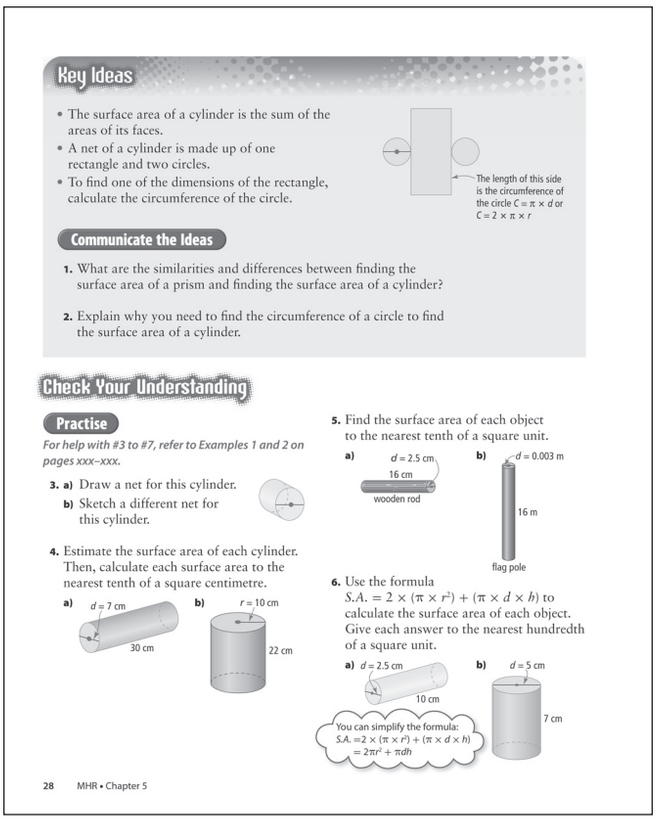
ELL

- For #1 in Communicate the Ideas, have students fill out a T-chart with the headings *Same* and *Different* and visuals of the surface area of a prism and a cylinder. Graphic organizers are a good way for English language learners to access the information being taught.

Answers

1. Answers may vary. For example:
   similarities – the surface area can be found by finding the total area of the shapes in its net; the surface area requires calculating the area of a rectangle
   differences – the surface area of a cylinder requires calculating the area and circumference of a circle, which is not required for a prism
2. In the net of a cylinder, one side of the rectangle is equal to the circumference of the circular base of the cylinder.

Assessment	Supporting Learning
Assessment *as* Learning	
Communicate the Ideas Have all students complete #1 and #2.	• Have students work in groups to develop ideas and then write their answers on their own. • Sharing the answers in a class discussion will benefit those students who are still unsure.



Key Ideas

- The surface area of a cylinder is the sum of the areas of its faces.
- A net of a cylinder is made up of one rectangle and two circles.
- To find one of the dimensions of the rectangle, calculate the circumference of the circle.

The length of this side is the circumference of the circle $C = \pi \times d$ or $C = 2 \times \pi \times r$

Communicate the Ideas

1. What are the similarities and differences between finding the surface area of a prism and finding the surface area of a cylinder?
2. Explain why you need to find the circumference of a circle to find the surface area of a cylinder.

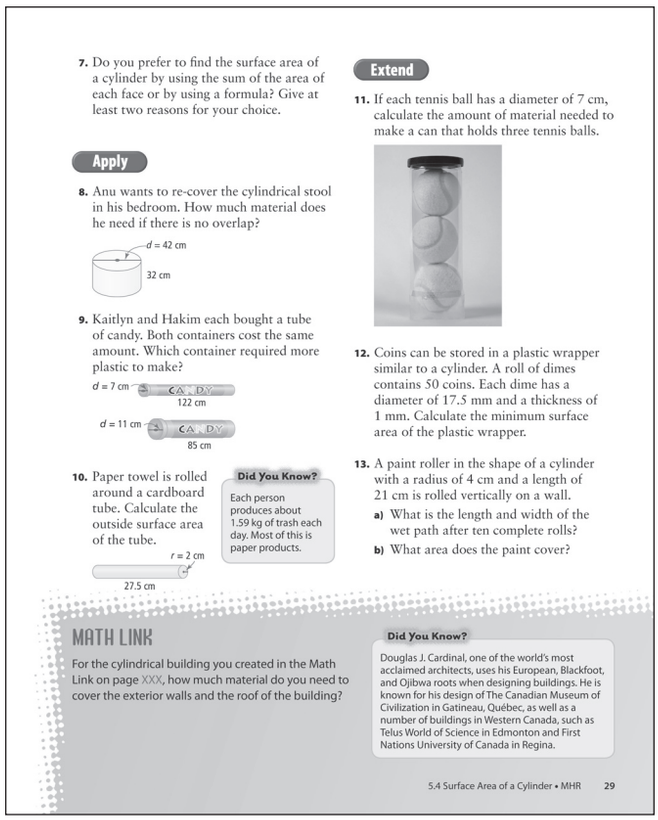
Check Your Understanding

Practise

For help with #3 to #7, refer to Examples 1 and 2 on pages xxx–xxx.

3. a) Draw a net for this cylinder.
   b) Sketch a different net for this cylinder.
4. Estimate the surface area of each cylinder. Then, calculate each surface area to the nearest tenth of a square centimetre.
   a) $d = 7$ cm, 30 cm
   b) $r = 10$ cm, 22 cm
5. Find the surface area of each object to the nearest tenth of a square unit.
   a) $d = 2.5$ cm, 16 cm, wooden rod
   b) $d = 0.003$ m, 16 m, flag pole
6. Use the formula $S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$ to calculate the surface area of each object. Give each answer to the nearest hundredth of a square unit.
   a) $d = 2.5$ cm, 10 cm
   b) $d = 5$ cm, 7 cm

You can simplify the formula:
$S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$
$= 2\pi r^2 + \pi dh$



7. Do you prefer to find the surface area of a cylinder by using the sum of the area of each face or by using a formula? Give at least two reasons for your choice.

Apply

8. Anu wants to re-cover the cylindrical stool in his bedroom. How much material does he need if there is no overlap?

9. Kaitlyn and Hakim each bought a tube of candy. Both containers cost the same amount. Which container required more plastic to make?

10. Paper towel is rolled around a cardboard tube. Calculate the outside surface area of the tube.

Did You Know?

Each person produces about 1.59 kg of trash each day. Most of this is paper products.

Extend

11. If each tennis ball has a diameter of 7 cm, calculate the amount of material needed to make a can that holds three tennis balls.

12. Coins can be stored in a plastic wrapper similar to a cylinder. A roll of dimes contains 50 coins. Each dime has a diameter of 17.5 mm and a thickness of 1 mm. Calculate the minimum surface area of the plastic wrapper.
13. A paint roller in the shape of a cylinder with a radius of 4 cm and a length of 21 cm is rolled vertically on a wall.
    a) What is the length and width of the wet path after ten complete rolls?
    b) What area does the paint cover?

MATH LINK

For the cylindrical building you created in the Math Link on page XXX, how much material do you need to cover the exterior walls and the roof of the building?

Did You Know?

Douglas J. Cardinal, one of the world's most acclaimed architects, uses his European, Blackfoot, and Ojibwa roots when designing buildings. He is known for his design of The Canadian Museum of Civilization in Gatineau, Québec, as well as a number of buildings in Western Canada, such as Telus World of Science in Edmonton and First Nations University of Canada in Regina.

Check Your Understanding

Practise

For #4 and #5, it is assumed that students will use the Method 1 strategy from Example 1 to answer the questions. Then, #6 specifies that students are to use the formula. In #7, students are asked to state which method they prefer. You may wish to assign a) or b) for #4–#6, instead of both, then use the remaining questions for extra practice.

Apply

As do the Check Your Understanding questions, the Apply questions ask students to find the surface area, but these questions place the problem within a context. Work with students to identify actual objects with the shapes in the various questions. You may have them calculate the surface area of specific shapes instead of the ones pictured in the textbook. The paper towel roll could be replaced by a toilet paper roll.

Extend

The Extend questions require students to perform multiple steps to find the solutions.

You may wish to have students compare their calculations for #12 to the actual dimensions of a plastic dime roll.

To extend #13, have students do the calculation for several rollers of various sizes.

Math Link

This Math Link is a continuation from Math Link 5.2. Students take the cylindrical building they designed and find the amount of material need to cover the sides and the roof. Students who missed 5.2 can create their building first, than do the calculations.

Meeting Student Needs

- Encourage students to estimate first if they are using decimal numbers.
- You may wish to provide **BLM 5–14 Section 5.4 Extra Practice** to students who require more practice. You will find the answers to this master on **BLM 5–18 Chapter 5 BLM Answers**.

ELL

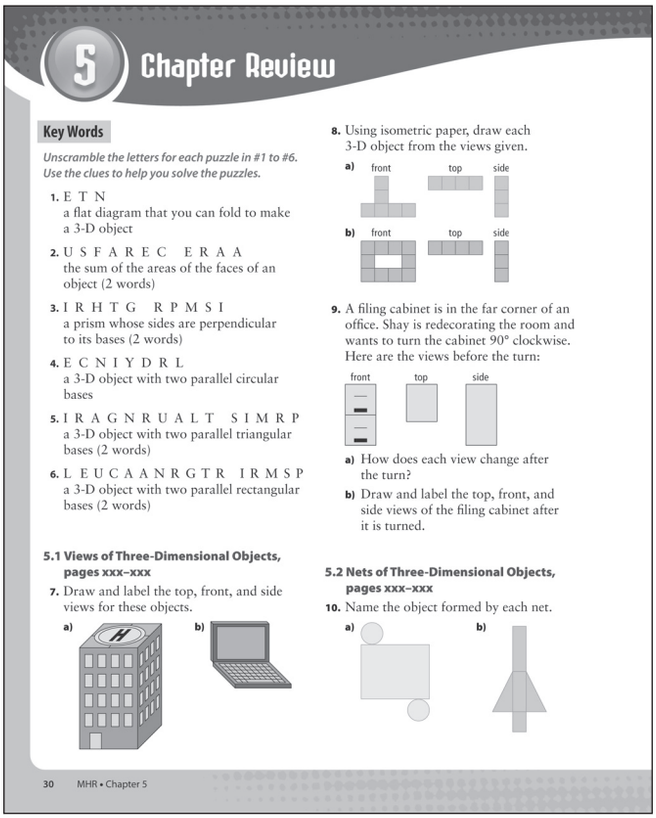
- For #4 in Check Your Understanding, demonstrate on the board and verbally what it means to estimate and then calculate for a question.
- For the Math Link, use a visual on the board while orally using the words minimum and maximum.

Answers

Math Link

Answers may vary. For example, for a cylindrical hotel building that is 60 m tall and 36 m in diameter, you would need about 4400 m^2 of material for the roof and the exterior walls.

Assessment	Supporting Learning
Assessment *for* Learning	
Practise Have students do questions 3, 4, and 6. Students who can readily do these questions can go on to the Apply questions; then try the Extend questions.	• Provide grid paper to students to assist them with #3. Have them compare their nets to other students. • Have students attempt #4 using the method with which they are most comfortable. Grid paper may be of assistance. Remind students to estimate and why estimating provides a link to the actual calculation. Provide assistance to students who need help with #4, coach them through or partner them with another student and clarify any misunderstandings. Encourage the students to try one of the question parts in #5 before going on. • Question 6 supports the use of the formula method. Students may not be comfortable with the use of the formula but they should be aware of what each part represents. To complete the question, allow students to use the method they are most comfortable with.
Math Link The Math Link on page xx is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page xx.	• Clarify that the building will have sides and the roof covered as the floor is not on the outside, but in the ground. • Students may benefit from checking each other's work for errors. • **BLM 5–15 Section 5.4 Math Link** provides scaffolding that will help some students complete the Math Link.
Assessment *as* Learning	
Math Learning Log Have students answer Practise #7 on page XX. Also, have them write down one example using their preferred method, separate from the questions or examples in the text. Have students complete the following statement: –The part I find most confusing in finding the surface area of a cylinder is …	• Have students discuss the answer with a partner before recording the answer on their own. • Encourage students to use the list of steps to solve a problem. • Encourage students to use the What I Need to Work On section of their chapter Foldable to note what they continue to have difficulties with.



5 Chapter Review

Key Words

Unscramble the letters for each puzzle in #1 to #6. Use the clues to help you solve the puzzles.

1. E T N
a flat diagram that you can fold to make a 3-D object
2. U S F A R E C E R A A
the sum of the areas of the faces of an object (2 words)
3. I R H T G R P M S I
a prism whose sides are perpendicular to its bases (2 words)
4. E C N I Y D R L
a 3-D object with two parallel circular bases
5. I R A G N R U A L T S I M R P
a 3-D object with two parallel triangular bases (2 words)
6. L E U C A A N R G T R I R M S P
a 3-D object with two parallel rectangular bases (2 words)

5.1 Views of Three-Dimensional Objects, pages xxx–xxx

7. Draw and label the top, front, and side views for these objects.

a) b)

8. Using isometric paper, draw each 3-D object from the views given.

a) front top side

b) front top side

9. A filing cabinet is in the far corner of an office. Shay is redecorating the room and wants to turn the cabinet 90° clockwise. Here are the views before the turn:

front top side

a) How does each view change after the turn?
b) Draw and label the top, front, and side views of the filing cabinet after it is turned.

5.2 Nets of Three-Dimensional Objects, pages xxx–xxx

10. Name the object formed by each net.

a) b)

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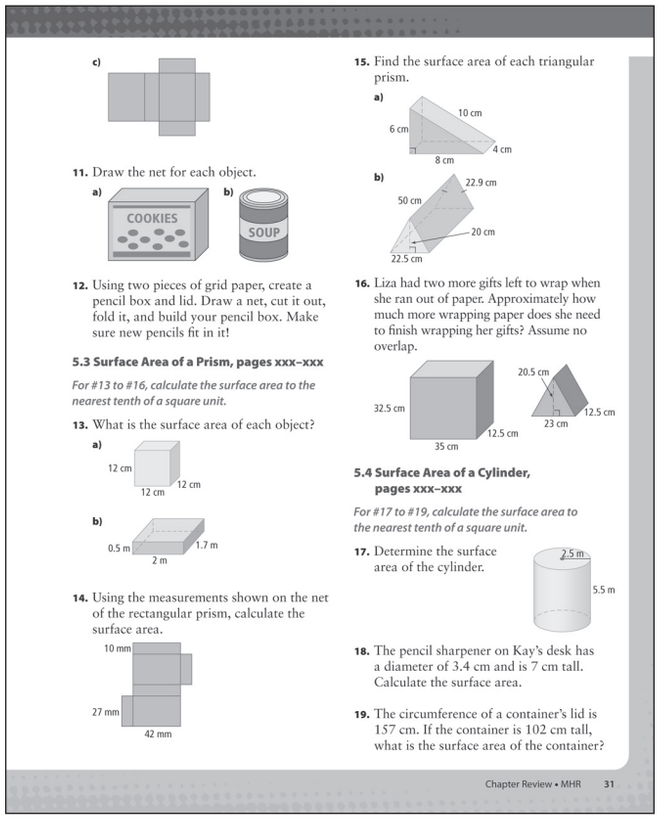


c)

11. Draw the net for each object.

a) b)

COOKIES SOUP

12. Using two pieces of grid paper, create a pencil box and lid. Draw a net, cut it out, fold it, and build your pencil box. Make sure new pencils fit in it!

5.3 Surface Area of a Prism, pages xxx–xxx

For #13 to #16, calculate the surface area to the nearest tenth of a square unit.

13. What is the surface area of each object?

a) 12 cm, 12 cm, 12 cm

b) 0.5 m, 1.7 m, 2 m

14. Using the measurements shown on the net of the rectangular prism, calculate the surface area.

10 mm, 27 mm, 42 mm

15. Find the surface area of each triangular prism.

a) 10 cm, 6 cm, 8 cm, 4 cm

b) 22.9 cm, 50 cm, 20 cm, 22.5 cm

16. Liza had two more gifts left to wrap when she ran out of paper. Approximately how much more wrapping paper does she need to finish wrapping her gifts? Assume no overlap.

32.5 cm, 12.5 cm, 35 cm; 20.5 cm, 12.5 cm, 23 cm

5.4 Surface Area of a Cylinder, pages xxx–xxx

For #17 to #19, calculate the surface area to the nearest tenth of a square unit.

17. Determine the surface area of the cylinder.

2.5 m, 5.5 m

18. The pencil sharpener on Kay's desk has a diameter of 3.4 cm and is 7 cm tall. Calculate the surface area.

19. The circumference of a container's lid is 157 cm. If the container is 102 cm tall, what is the surface area of the container?

Chapter Review • MHR 31

***MathLinks 8*, pages xx–xx**

Suggested Timing
40–50 minutes

Materials
- grid paper
- ruler
- scissors

Blackline Masters
Master 7 Isometric Dot Paper
Master 8 Centimetre Grid Paper
BLM 5–6 Section 5.1 Extra Practice
BLM 5–9 Section 5.2 Extra Practice
BLM 5–11 Section 5.3 Extra Practice
BLM 5–14 Section 5.4 Extra Practice

Planning Notes

Have students list the answers to the Key Words section on paper. When they are done, have them look though the four chapter sections in the textbook. If there is a particular section they had difficulties with, encourage them to do every question in that section of the review. In the other sections, students could do a) or b) if they understand the concept.

Meeting Student Needs

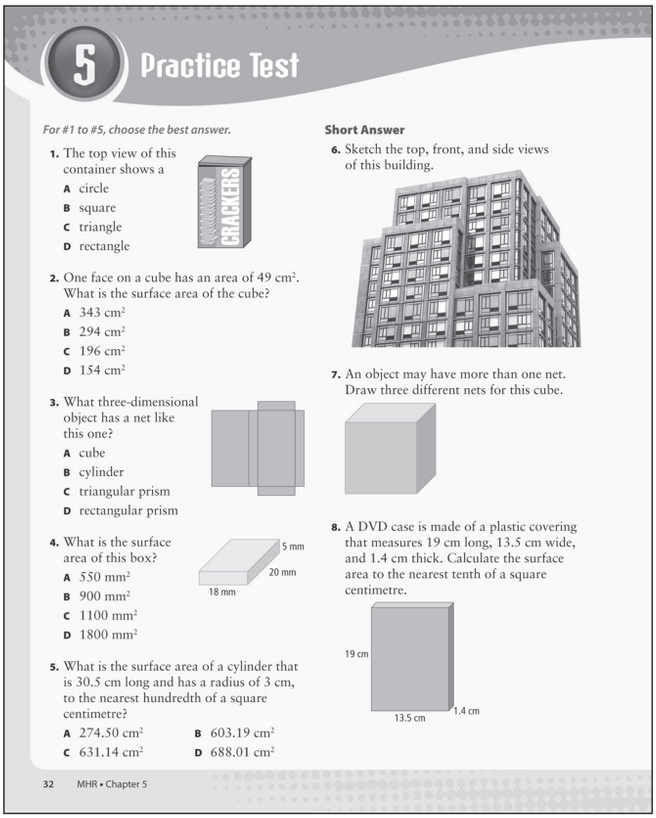
- Have students correct another classmate's answers so they can go back and try to correct their mistakes.
- Students who require more practice on a particular topic may refer to the following blackline masters: **BLM 5–6 Section 5.1 Extra Practice**, **BLM 5–9 Section 5.2 Extra Practice**, **BLM 5–11 Section 5.3 Extra Practice**, and **BLM 5–14 Section 5.4 Extra Practice**.

ELL

- Give English language learners the vocabulary words to use for the puzzle review of key words.

Assessment	Supporting Learning
Assessment *for* Learning	
Chapter 5 Review The Chapter 5 Review is an opportunity for students to assess themselves by completing selected questions in each section and checking their answers against the answers in the back of the student resource.	• Have students check the contents of the What I Need to Work On section of their chapter Foldable and do at least one question related to each item on that tab. • Have students revisit any section that they are having difficulty with prior to working on the chapter test.

Practice Test 5



5 Practice Test

For #1 to #5, choose the best answer.

1. The top view of this container shows a

A circle
B square
C triangle
D rectangle

2. One face on a cube has an area of 49 cm^2. What is the surface area of the cube?
A 343 cm^2
B 294 cm^2
C 196 cm^2
D 154 cm^2

3. What three-dimensional object has a net like this one?

A cube
B cylinder
C triangular prism
D rectangular prism

4. What is the surface area of this box?

A 550 mm^2
B 900 mm^2
C 1100 mm^2
D 1800 mm^2

5. What is the surface area of a cylinder that is 30.5 cm long and has a radius of 3 cm, to the nearest hundredth of a square centimetre?
A 274.50 cm^2
B 603.19 cm^2
C 631.14 cm^2
D 688.01 cm^2

Short Answer

6. Sketch the top, front, and side views of this building.

7. An object may have more than one net. Draw three different nets for this cube.

8. A DVD case is made of a plastic covering that measures 19 cm long, 13.5 cm wide, and 1.4 cm thick. Calculate the surface area to the nearest tenth of a square centimetre.

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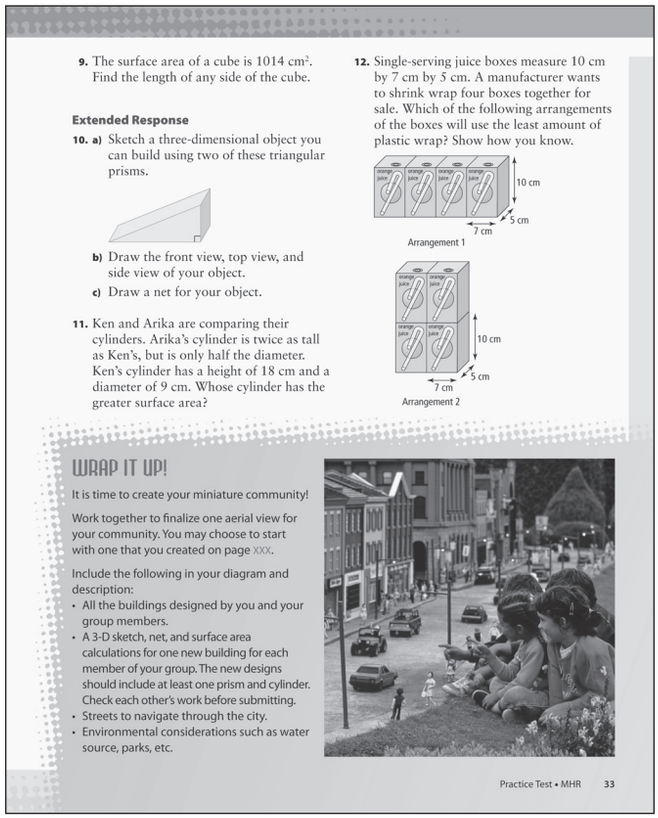


9. The surface area of a cube is 1014 cm^2. Find the length of any side of the cube.

Extended Response

10. a) Sketch a three-dimensional object you can build using two of these triangular prisms.

b) Draw the front view, top view, and side view of your object.
c) Draw a net for your object.

11. Ken and Arika are comparing their cylinders. Arika's cylinder is twice as tall as Ken's, but is only half the diameter. Ken's cylinder has a height of 18 cm and a diameter of 9 cm. Whose cylinder has the greater surface area?

12. Single-serving juice boxes measure 10 cm by 7 cm by 5 cm. A manufacturer wants to shrink wrap four boxes together for sale. Which of the following arrangements of the boxes will use the least amount of plastic wrap? Show how you know.

Arrangement 1

Arrangement 2

WRAP IT UP!

It is time to create your miniature community!

Work together to finalize one aerial view for your community. You may choose to start with one that you created on page xxx.

Include the following in your diagram and description:
- All the buildings designed by you and your group members.
- A 3-D sketch, net, and surface area calculations for one new building for each member of your group. The new designs should include at least one prism and cylinder. Check each other's work before submitting.
- Streets to navigate through the city.
- Environmental considerations such as water source, parks, etc.

Practice Test • MHR 33

***MathLinks 8*, pages xx–xx**

Suggested Timing
40–50 minutes

Materials
- grid paper
- ruler

Blackline Masters
Master 8 Centimetre Grid Paper
BLM 5–16 Chapter 5 Test

Planning Notes

Allow time for students to clarify any misunderstandings before beginning the Practice Test. Have students first complete the questions they know they can do. Then, have them complete the questions they know something about. Finally, have them do their best on the questions that they are still struggling with.

This Practice Test can be assigned as an in-class or take-home assignment. The minimum questions that students need to complete to meet the related curriculum outcomes include: #3–#7, and #9.

Meeting Student Needs

- Allow kinesthetic and concrete learners to use 3-D objects as needed.

Study Guide

Question(s)	Section(s)	Refer to	The student can …
1, 6	5.1	Explore the Math, Example 1	✓ draw and label top, front, and side views of 3-D objects
2, 4	5.3	Example 1	✓ link area to surface area
3, 7	5.2	Example 1	✓ determine the correct nets for 3-D objects
5	5.4	Example 1, Example 2	✓ find the surface area of a cylinder
8, 9, 12	5.3	Explore the Math, Example 1	✓ link area to surface area
10	5.1 5.2	Explore the Math, Example 1 Example	✓ draw and label top, front, and side views of 3-D objects ✓ determine the correct nets for 3-D objects ✓ draw nets for 3-D objects
11	5.4	Explore the Math, Examples 1 and 2	✓ find the surface area of a cylinder

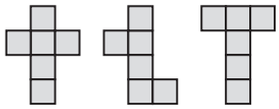
Answers

Chapter 5 Practice Test

1. D **2.** B **3.** D **4.** C **5.** C

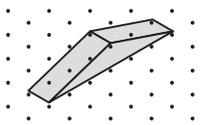
6. Answers may vary. For example,
<to come>

7. Answers may vary. For example,



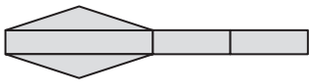
8. 604.0 cm^2 **9.** 13 cm

10. a) Answers may vary. For, example,



b) Answers may vary. For example,

c) Answers may vary. For example,

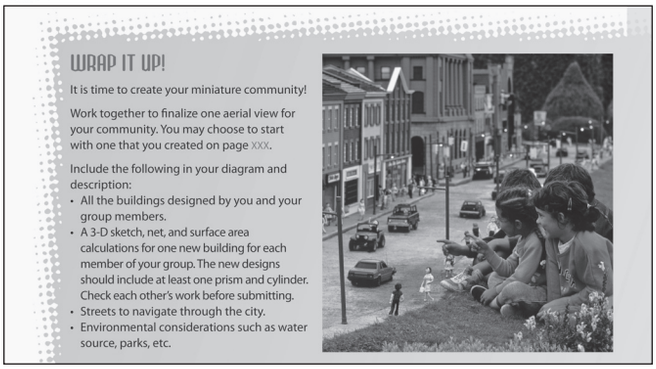


11. Ken's cylinder of surface area 635.85 cm^2 has a greater surface area than Arika's cylinder of surface area 540.47 cm^2.

12. Arrangement 2 will use a lesser amount of plastic wrap as its surface area is 760 cm^2 while the surface area of Arrangement 1 is 940 cm^2.

Assessment	Supporting Learning
Assessment *as* Learning	
Chapter 5 Self-Assessment Have students review their earlier responses in the What I Need to Work on section(s) of their chapter Foldables.	• Allow kinesthetic and concrete learners to use 3-D objects as needed. • Have students use their responses on the Practice Test and on the work they completed earlier in the chapter to identify areas in which they may need to reinforce their understanding of skills or concepts. Before beginning the Chapter Test, coach them in the areas in which they are having difficulties.
Assessment *for* Learning	
Chapter 5 Test After students complete the Practice Test, you may wish to use **BLM 5–16 Chapter 5 Test** as a summative assessment.	• Consider allowing students to use their chapter Foldables. • Consider using the Math Games on page xx or the Challenge in Real Life on page xx to assess the knowledge and skills of students who have difficulty with tests. • Allow kinesthetic and concrete learners to use 3-D objects as needed.

Wrap It Up!



***MathLinks 8*, page xx**

Suggested Timing
80–100 minutes

Materials
- grid paper
- building materials (e.g., boxes, cans, glue, tape, etc.) (optional)
- ruler
- coloured pencils

Blackline Masters
Master 1 Project Rubric
Master 8 Centimetre Grid Paper
BLM 5–1 Math Link Introduction
BLM 5–7 Section 5.1 Math Link
BLM 5–10 Section 5.2 Math Link
BLM 5–12 Section 5.3 Math Link
BLM 5–15 Section 5.4 Math Link
BLM 5–17 Chapter 5 Wrap It Up!

Specific Outcomes
SS2 Draw and construct nets for 3-D objects.
SS3 Determine the surface area of:
- right rectangular prisms
- right triangular prisms
- right cylinders

to solve problems.
SS5 Draw and interpret top, front and side views of 3-D objects composed of right rectangular prisms.

Planning Notes

Throughout the Math Links in this chapter, students have been drawing buildings for a miniature community. You may wish to provide an opportunity for groups of students or for the class as a whole to build a model of a miniature community based on their aerial views.

Meeting Student Needs

- Depending on time and the ability of your students, you may wish to have students work in groups or as a whole class to complete the task. If you choose to have them work as a class, be sure to decide on one aerial view for the class to use.

Common Errors

- Students may create buildings of incongruent sizes, such as houses that are vastly larger than hospitals.

R_x Ensure students understand that residential houses should be close in height, whereas public institutions such as hospitals and community centres should be larger, and encourage them to check in with each other while they are planning their construction efforts.

Assessment	Supporting Learning
Assessment of Learning	
Wrap It Up! This chapter problem wrap-up gives students an opportunity to apply and display their knowledge of views, nets, and the surface area of 3-D objects, including prisms and cylinders. It is important for students to be realistic and creative and to communicate with their classmates. **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this Wrap It Up! Page xx in this TR provides notes on how to use this rubric for the Wrap It Up!	• You may wish to have students review the work they have completed in the Math Links in sections 5.2 and 5.3 before they begin. • If students have not completed the Math Links, you may wish to provide them with **BLM 5–1 Math Link Introduction**, **BLM 5–7 Section 5.1 Math Link**, **BLM 5–10 Section 5.2 Math Link**, **BLM 5–12 Section 5.3 Math Link**, and **BLM 5–15 Section 5.2 Math Link** • You may wish to have students use **BLM 5–17 Chapter 5 Wrap It Up!**, which provides scaffolding for the chapter problem wrap-up.

The chart below shows the **Master 1 Project Rubric** for tasks such as the Wrap It Up!, and provides notes that specify how to identify the level of specific answers for the project.

Score/Level	Holistic Descriptor	Specific Question Notes
5 **(Standard of Excellence)**	❑ Applies/develops **thorough** strategies and mathematical processes making **significant** comparisons/connections that demonstrate a **comprehensive** understanding of how to develop a complete solution ❑ Procedures are **efficient and effective** and may contain a **minor mathematical error** that does not affect understanding ❑ Uses **significant** mathematical language to explain their understanding and provides **in-depth** support for their conclusion	• provides complete and correct solution • may have a minor labelling omission but it does not hinder the solution
4 **(Above Acceptable)**	❑ Applies/develops **thorough** strategies and mathematical processes for making **reasonable** comparisons/connections that demonstrate a **clear** understanding ❑ Procedures are **reasonable** and may contain a **minor mathematical error** that may hinder the understanding in one part of a complete solution ❑ Uses **appropriate** mathematical language to explain their understanding and provides **clear** support for their conclusion	• provides a complete response but the miniature community lacks one of the requirements. For example, it lacks labelling, ignores a major environmental consideration*, or does not represent an aerial view) *or* • addresses all the environmental considerations and completes an aerial view, but shows an error in one of the new buildings' requirements (net or 3-D sketch or surface area calculation). * An environmental consideration will include water, sewage, power, parks, roads
3 **(Meets Acceptable)**	❑ Applies/develops **relevant** strategies and mathematical processes making **some** comparisons/connections that demonstrate a **basic** understanding ❑ Procedures are **basic** and may contain a **major error or omission** ❑ Uses **common** language to explain their understanding and provides **minimal** support for their conclusion	• provides a significant start to the community design • provides some correct nets, and some calculations of surface area but is not complete • errors or omissions do not allow this work to go beyond the basic understanding.
2 **(Below Acceptable)**	❑ Applies/develops **some relevant** mathematical processes making **minimal** comparisons/connections that lead to a **partial solution** ❑ Procedures are **basic** and may contain **several major mathematical errors** ❑ Communication is **weak**	• identifies minimal structures and attempts the designs with several errors • provides basic calculations and deals primarily with rectangular prisms • may or may not provide nets • shows errors in 3-D diagrams • labelling is absent
1 **(Beginning)**	❑ Applies/develops an **initial start** that may be **partially correct** or could have led to a correct solution ❑ Communication is **weak or absent**	• makes an initial design or lists the buildings for the community • provides some initial calculations but the work does not make any significant step in the solution of the problem

Running 1 Line Too Long

Math Games

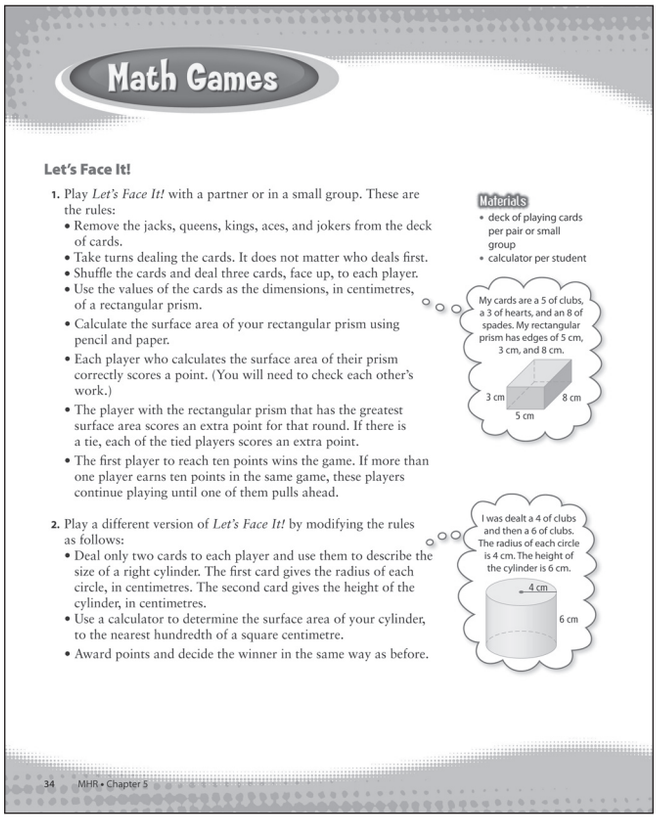
***MathLinks 8*, pages xx–xx**

Suggested Timing
20–40 minutes

Materials
- deck of playing cards per pair or small group
- calculator per student

Specific Outcomes
SS3 Determine the surface area of:
- right rectangular prisms
- right triangular prisms
- right cylinders

to solve problems.
SS4 Develop and apply formulas for determining the volume of right prisms and right cylinders.



Math Games

Let's Face It!

1. Play *Let's Face It!* with a partner or in a small group. These are the rules:
   - Remove the jacks, queens, kings, aces, and jokers from the deck of cards.
   - Take turns dealing the cards. It does not matter who deals first.
   - Shuffle the cards and deal three cards, face up, to each player.
   - Use the values of the cards as the dimensions, in centimetres, of a rectangular prism.
   - Calculate the surface area of your rectangular prism using pencil and paper.
   - Each player who calculates the surface area of their prism correctly scores a point. (You will need to check each other's work.)
   - The player with the rectangular prism that has the greatest surface area scores an extra point for that round. If there is a tie, each of the tied players scores an extra point.
   - The first player to reach ten points wins the game. If more than one player earns ten points in the same game, these players continue playing until one of them pulls ahead.

Materials
- deck of playing cards per pair or small group
- calculator per student

My cards are a 5 of clubs, a 3 of hearts, and an 8 of spades. My rectangular prism has edges of 5 cm, 3 cm, and 8 cm.

3 cm, 8 cm, 5 cm

2. Play a different version of *Let's Face It!* by modifying the rules as follows:
   - Deal only two cards to each player and use them to describe the size of a right cylinder. The first card gives the radius of each circle, in centimetres. The second card gives the height of the cylinder, in centimetres.
   - Use a calculator to determine the surface area of your cylinder, to the nearest hundredth of a square centimetre.
   - Award points and decide the winner in the same way as before.

I was dealt a 4 of clubs and then a 6 of clubs. The radius of each circle is 4 cm. The height of the cylinder is 6 cm.

4 cm, 6 cm

34 MHR • Chapter 5

Planning Notes

Before having students play the game, you may wish to read the directions with the class and then have a small group of students do a demonstration round to show how to play the game.

For the demonstration round, have the players calculate the surface area of the prism and class members check that calculation.

Discuss who has the greatest surface and how to award the points.

Meeting Student Needs

- Partner students with others of similar skill. Having evenly matched players will make the game more interesting.

Gifted and Enrichment

- You may wish to have students mentally estimate the surface areas for the first game, then do the calculations for the second game.

Common Errors

- Students might calculate volume, rather than surface area, to determine the winner.

R_x Make sure that students check each others' calculations to ensure they are using the proper formula.

Assessment	Supporting Learning
Assessment *for* Learning	
Let's Face It! Have student play this game with a partner or small group (three or four students) of similar ability.	• Encourage students to write out the dimensions on a piece of paper, showing their thinking. • Listen to the discussion that surrounds the calculation of surface area for the rectangular prism. Clarify any misunderstandings. • After the students have played the first part of the game, have them complete the same for cylinders as outlined in #2. • This game could be played at different times; with rectangular prisms after section 5.3, and with cylinders after section 5.4. • After students have played the game once or twice, brainstorm whether it matters which card is assigned which dimension. Ask students if the three cards they get for the rectangular prism would change the surface area of they were assigned differently. Ask the same of the cylinder: Would it change the surface area if you could decide which value was the radius and which was the height? • You may wish to have students replay the game, asking them to decide which value to assign to radius and height.

Challenge in Real Life

***MathLinks 8*, page xx**

Suggested Timing
Two classes of 40–50 minutes, with possible follow-up

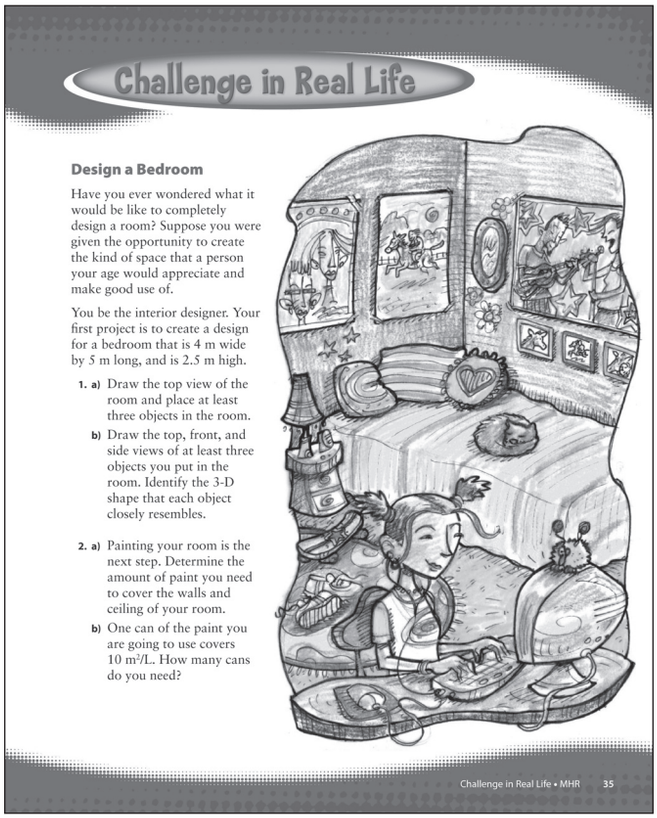
Materials
- scissors
- magazine images of bedroom designs

Blackline Masters
Master 1 Project Rubric
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☑ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☑ Reasoning (R)
- ☐ Technology (T)
- ☑ Visualization (V)

Specific Outcomes
SS2 Draw and construct nets for 3-D objects.
SS3 Determine the surface area of:
- right rectangular prisms
- right triangular prisms
- right cylinders

to solve problems
SS5 Draw and interpret top, front and side views of 3-D objects composed of right rectangular prisms.


Challenge in Real Life

Design a Bedroom

Have you ever wondered what it would be like to completely design a room? Suppose you were given the opportunity to create the kind of space that a person your age would appreciate and make good use of.

You be the interior designer. Your first project is to create a design for a bedroom that is 4 m wide by 5 m long, and is 2.5 m high.

1. a) Draw the top view of the room and place at least three objects in the room.
   b) Draw the top, front, and side views of at least three objects you put in the room. Identify the 3-D shape that each object closely resembles.
2. a) Painting your room is the next step. Determine the amount of paint you need to cover the walls and ceiling of your room.
   b) One can of the paint you are going to use covers 10 m^2/L. How many cans do you need?

Challenge in Real Life • MHR 35

Planning Notes

You may wish to use the following steps to introduce and complete this challenge:

1. Introduce the challenge by asking students to envision their classroom as an empty space that could be used to create a student lounge. Ask them what sort of furniture would be needed to make a space where students could relax, eat lunch, do homework, or play indoor games. Then, ask students how thinking in 3-D might help them design a useful space. Ask when they might need to calculate surface area in order to redecorate a space.
2. Challenge students to imagine that they have a job designing an amazing bedroom for a student their age. Discuss the following questions:
   - What furniture might they include?
   - Where would they place each piece?
   - How might thinking in 3-D help them place the furniture?
   - How might a net be helpful in showing the design of an object?
   - When might they need to know the surface area of an item? (e.g., for painting, re-covering furniture, etc.)

   For students experiencing design difficulties, ask them to draw their bedrooms.
3. Provide students with **Master 8 Centimetre Grid Paper** or **Master 9 0.5 Centimetre Grid Paper**, depending on how large or small the room is going to be.
4. Clarify that the task is to:
   - create a design for a bedroom and draw the top view of this design
   - draw several views of furniture they might wish to place in the room
   - calculate how many litres of paint they would need to paint the walls and ceiling of the room

   NOTE: Scale is not part of the grade 8 curriculum. It is not necessary for students to do any of this activity to scale.

5. Review Master 1 Project Rubric with students so that they will know what is expected of them.

Meeting Student Needs

- Encourage students to create their own furniture, such as a combination bed and computer gaming structure.
- Allow students to cut out pictures of furniture and experiment with where to place them before finalizing the design.
- Have oral learners describe their ideas to visual learners who may then create drawings.

Gifted and Enrichment

- Challenge gifted and enriched students by asking them to calculate the amount of material they would need to re-cover a stool in their redesigned bedroom.

This challenge can be used for either Assessment *for* Learning or Assessment *of* Learning.

Assessment	Supporting Learning
Assessment *for* Learning	
Design a Bedroom Discuss the challenge with the class. Have students brainstorm the types of things they would like to place in a bedroom for which they could draw the views. Discuss what is important to consider when drawing the views of objects. Encourage students to be creative and use objects that are not simply rectangular prisms. Discuss with the group what painting the walls in a room means, mathematically. You may also need to discuss what is being painted and how paint is purchased.	• Review with students how to draw the views of objects and the different 3-D shapes. • Remind students that they must draw at least three objects and show their placement in the room from a top view. • You may need to discuss paint purchases as some students may not be familiar with this process. • Ask students to consider if they will use more than one colour. • For a second challenge, complete with teaching notes and student exemplars, go to www.mathlinks8.ca, access the Teachers' site, go to Assessment, then follow the links.
Assessment *of* Learning	
Design a Bedroom Discuss the challenge with the class. Have students draw a sketch of the room and label the items they wish to put in. Have them share their design with a partner and discuss their ideas and get feedback. Then have them complete the challenge independently.	• **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this challenge. Page XX provides notes on how to use this rubric for this challenge. • To view student exemplars, go to www.mathlinks8.ca, Remind students that they must draw at least three objects and show their placement in the room from a top view.

The chart below shows the **Master 1 Project Rubric** for tasks such as the Challenge in Real Life and provides notes that specify how to identify the level of specific answers for this project.

Score/Level	Holistic Descriptor	Specific Question Notes
5 **(Standard of Excellence)**	❑ Applies/develops **thorough** strategies and mathematical processes making **significant** comparisons/connections that demonstrate a **comprehensive** understanding of how to develop a complete solution ❑ Procedures are **efficient and effective** and may contain a **minor mathematical error** that does not affect understanding ❑ Uses **significant** mathematical language to explain their understanding and provides **in-depth** support for their conclusion	• provides a complete and correct solution
4 **(Above Acceptable)**	❑ Applies/develops **thorough** strategies and mathematical processes for making **reasonable** comparisons/connections that demonstrate a **clear** understanding ❑ Procedures are **reasonable** and may contain a **minor mathematical error** that may hinder the understanding in one part of a complete solution ❑ Uses **appropriate** mathematical language to explain their understanding and provides **clear** support for their conclusion	• provides a complete response with a rounding error in 2b) (rounds the number of cans of paint down) *or* • provides a complete response with an error in 1a) but correctly completes 1b), weak communication part 1c) *or* • provides a complete response with a correct 2b) or an incorrect 2a) (minor calculation error but the concept of surface area is understood)
3 **(Meets Acceptable)**	❑ Applies/develops **relevant** strategies and mathematical processes making **some** comparisons/connections that demonstrate a **basic** understanding ❑ Procedures are **basic** and may contain a **major error or omission** ❑ Uses **common** language to explain their understanding and provides **minimal** support for their conclusion	• completes parts 1 and 2a) *or* • provides a partially correct start to all parts of the question
2 **(Below Acceptable)**	❑ Applies/develops **some relevant** mathematical processes making **minimal** comparisons/connections that lead to a **partial solution** ❑ Procedures are **basic** and may contain **several major mathematical errors** ❑ Communication is **weak**	• completes parts 1a) and b) *or* • completes part 2a) and b)
1 **(Beginning)**	❑ Applies/develops an **initial start** that may be **partially correct** or could have led to a correct solution ❑ Communication is **weak or absent**	• attempts to start any one or both parts of the problem *or* • completes part 1a)

For student exemplars, go to www.mathlinks8.ca and follow the links.