5.2 Nets of Three-Dimensional Objects

***MathLinks 8*, pages 170–175**

Suggested Timing
80–100 minutes

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

Blackline Masters
Master 2 Two Stars and One Wish
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)

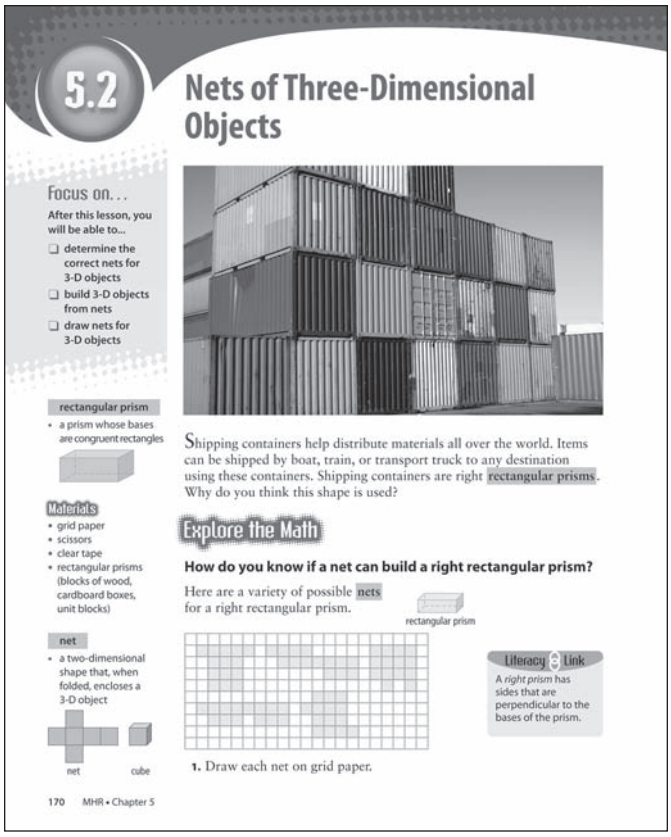
Specific Outcomes
SS2 Draw and construct nets for 3-D objects.

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, 3, 7, 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

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

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

net cube

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?

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

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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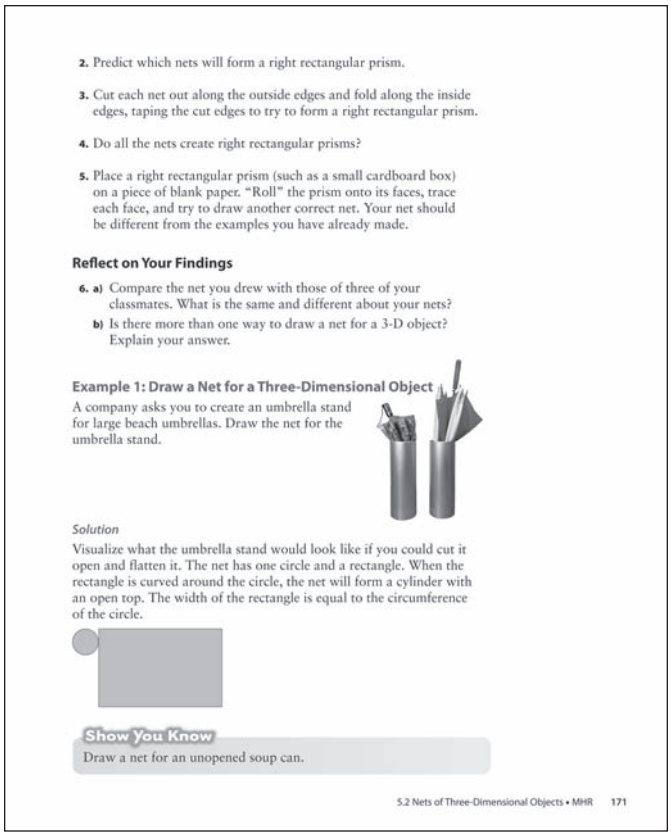
Explore the Math

As a class, read the definitions of *rectangular prism* and *net* found on page 170.

Literacy Link Direct students to the Literacy Link on page 170 that explains the term *right prism*.

Method 1 Have students work in pairs. 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.

Method 2 Have students work in pairs or groups of three to draw the nets on a large piece of chart paper, cut them out, and fold and tape them to create rectangular prisms. Before starting to fold, have students predict which nets will form prisms.



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.

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.

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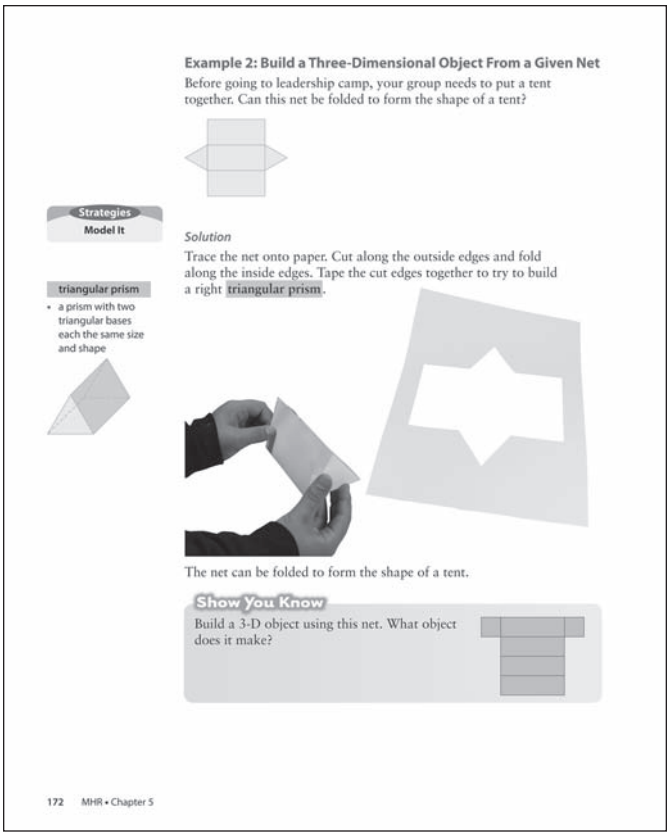

Example 2: Build a Three-Dimensional Object From a Given Net

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

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.

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

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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Have students use a cardboard shoe box and chart paper to draw a net that is different from the other ones they have done. Challenge them to be ready to explain how their net is different.

Ask each group to share its conclusions with at least one other group. Challenge them to develop as many different nets as they can for a rectangular prism

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* on page 172. Have students work through the example and the Show You Know and share their solutions with a classmate.

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 with **BLM 5–8 Section 5.2 Example 2** to cut and tape.
- Provide cans and/or other cylinders that students can trace to help visualize and draw cylindrical nets.
- Students may benefit from using larger cutouts.
- Have students provide their answers orally.
- Have students identify special objects that are prisms, such as parfleche-style containers, feather boxes, hope chests, birchbark boxes, and cedar boxes.

ELL

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

Gifted and Enrichment

- For the Example 2 Show You Know, have students draw a design on the net, and then see how the design fits together as they build it.

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.

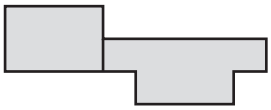
R_x Remind students that the pieces need to be the correct size to fit together (especially the circles on a cylinder). See the net for the Example 1 Show You Know.

Answers

Explore the Math

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

5. Drawings will vary. Look for an accurate net of the right rectangular prism. Example:



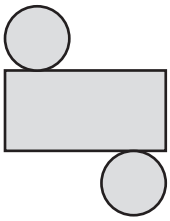
6. a) Answers may vary. Look for a similarity and a difference. Example: The number of squares in each net is the same. The shape of the nets vary.

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.

Show You Know: Example 1

Drawings will vary. Look for the following:
- an accurate net with two circles (one for the top and one for the bottom)
- the length of the rectangle should be slightly more than three times the diameter of the circle
- the width of the rectangle should be the height of the cylinder

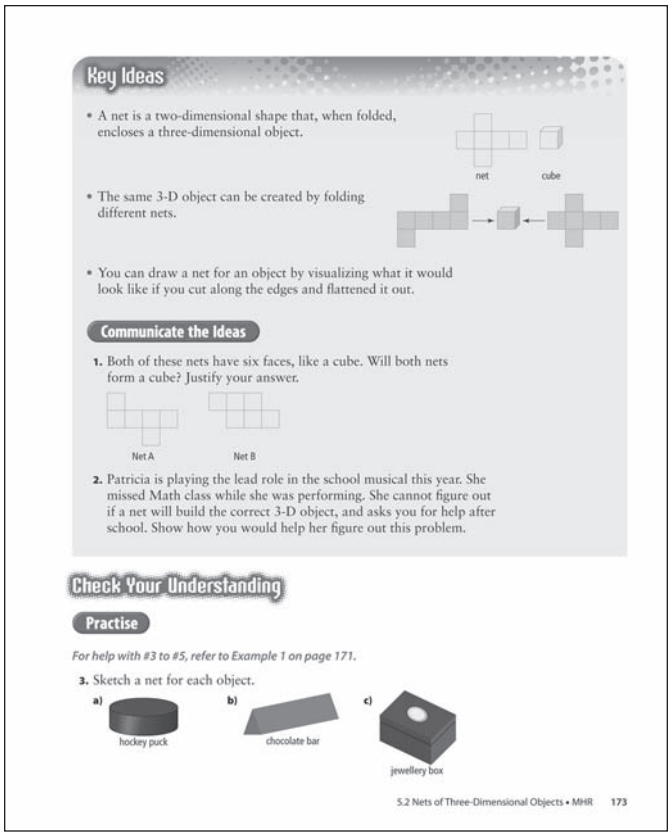
Example:



Show You Know: Example 2

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 to get them started. • Encourage students to check with more than three classmates if they all have the same net. • Discuss #6b) with the class so students may use the 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 You Know, some students may need more than one practice activity. Provide extra practice by choosing other items in the classroom for students to draw. Students 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 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.
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 and describe what they would look like from each view.



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 171.

3. Sketch a net for each object.

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

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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 their Key Ideas notes.

Communicate the Ideas

These questions give students an opportunity to explain their understanding of nets of 3-D objects. You may wish to use student responses to this section to assess their understanding of nets and ability to draw nets, and create correct 3-D objects.

Meeting Student Needs

- For #1, students may benefit from manipulating a copy of the nets to see if they form a cube.

Common Errors

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

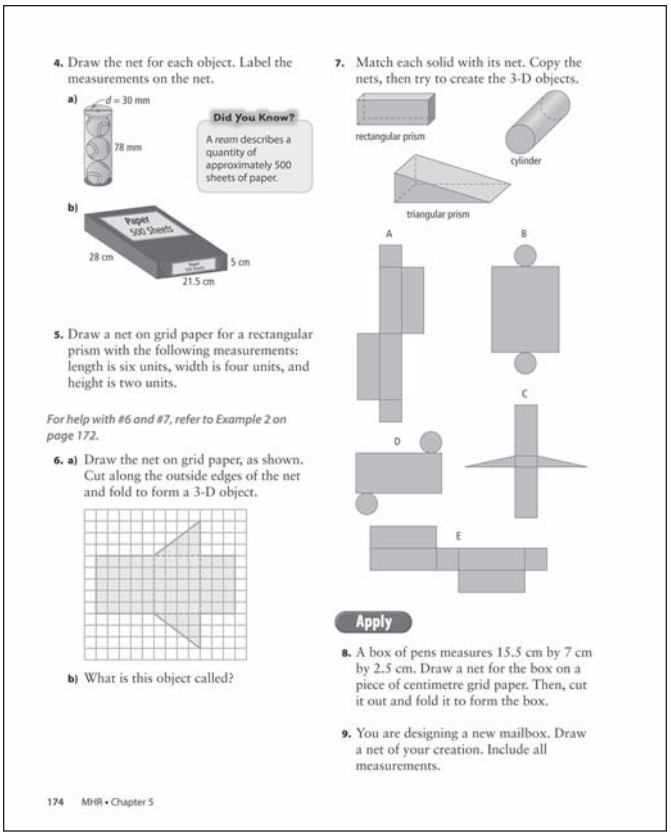
R_x Remind students to use manipulatives if they have difficulty visualizing whether or not a net is correct.

Answers

Communicate the Ideas

1. No, only Net A will fold to form a cube.
2. Answers may vary. 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 grid paper to build the nets for #1. • To ensure understanding, encourage 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 172.

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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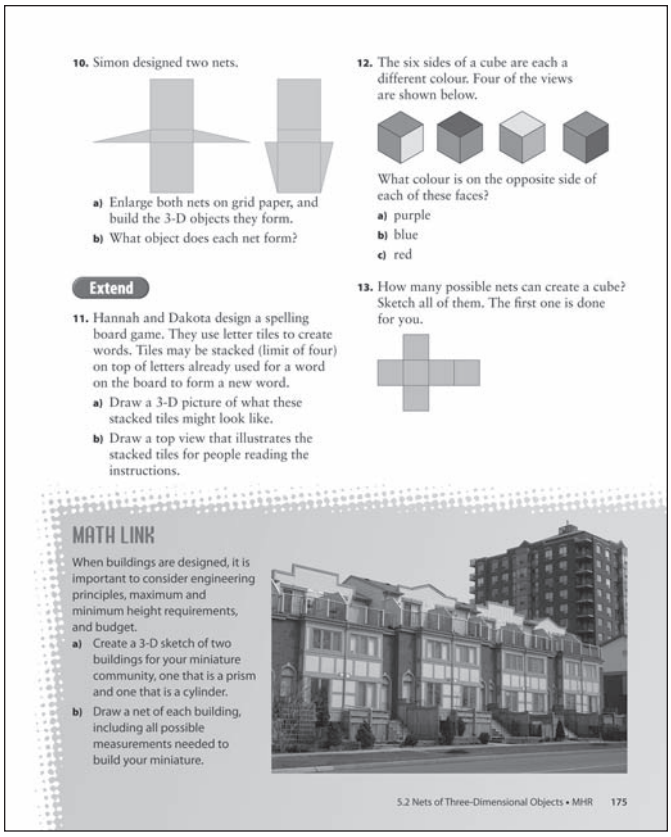

10. Simon designed two nets.

a) Enlarge both nets on grid paper, and build the 3-D objects they form.
b) What object does each net form?

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

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.

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.

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Check Your Understanding

Practise

Have students work in pairs or small groups. Students should discuss the work and agree on answers. You may want to consider time constraints when assigning specific questions. Students with strong spatial awareness will find this section easy to complete. Students who have difficulty with this skill will take longer to draw a net, cut it out, and build it. Several questions ask students to draw nets. Allow students who have no difficulty with this skill to move on to the Apply and Extend questions.

Apply

For #8, provide students with **Master 8 Centimetre Grid Paper**.

For #9, you may wish to have each student draw their own design and then construct it.

Extend

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

Challenge students to discover all of the ways to construct a cube 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 do not 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 (e.g., residental home, public hospital). At this point you might want to incorporate some of the discussion about essential buildings from the chapter opener.

Consider allowing students to work with a partner and have each student create a sketch of one building. You might provide suggestions for measurements if students need help.

Meeting Student Needs

- For #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.
- Provide **BLM 5–9 Section 5.2 Extra Practice** to students who would benefit from more practice.

Gifted and Enrichment

- Encourage students who have an interest in music to make a net for a drum.
- 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 available locally. For example, the Inuit have quite a unique drum design. You may wish to invite someone who is familiar with a special drum to demonstrate it to the class. If possible, have students take measurements of the drum and draw a net for the drum.

Web Link

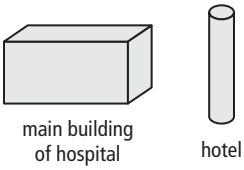
Have students research miniature buildings and communities to get ideas for their buildings. For more information about miniature communities, go to www.mathlinks8.ca.

Answers

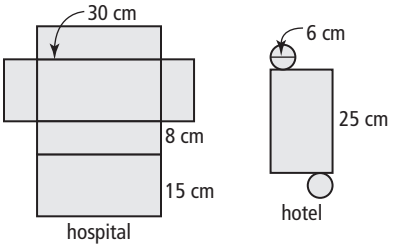
Math Link

a) Drawings will vary. Look for the following:
- 3-D drawings of a prism- and a cylinder-shaped building
- nets that accurately represent the drawings, including measurements

Examples:



b)



Assessment	Supporting Learning
Assessment *for* Learning	
Practise and Apply Have students do #3, #7, and #10. Students who can readily do these questions can go on to the rest of the Apply questions.	• For #3, provide additional coaching to students who need help with drawing nets and building objects. Allowing them to use grid paper may be beneficial. Clarify any misunderstandings and then have them do #4. • Students who need assistance with #7 may need to be coached through shape A. Have students explain what the different faces are and how those shapes would look separately. Help students link their thinking to the given net design. Have them try shapes B, C, and D before continuing. • For #10, students may benefit from a discussion about how to enlarge the nets. They may find it easiest to use centimetre grid paper and multiply all measurements by 10.
Math Link The Math Link on page 175 is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page 191.	• Have students exchange their work with a classmate to check for errors and suggest improvements. You may wish to provide students with **Master 2 Two Stars and One Wish** for recording their feedback. • Some students may benefit from a class discussion of the typical heights of buildings. • Consider allowing students to use computer software such as, *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 3-D 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.