Views of Three-Dimensional Objects

5.1

***MathLinks 8*, pages 164–169**

Suggested Timing
80–100 minutes

Materials
- 20 unit blocks
- masking tape
- isometric dot paper
- cardboard box
- transparent tape

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)

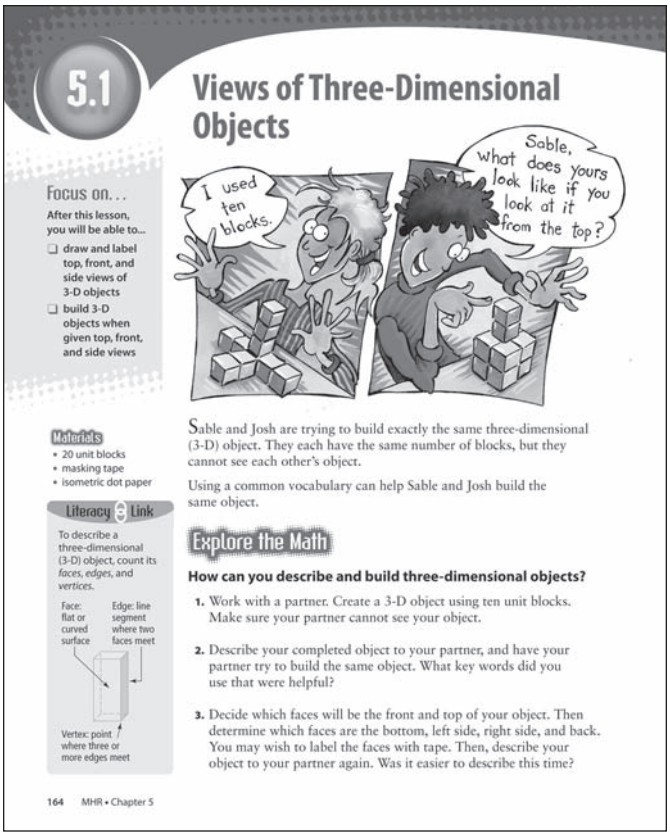
Specific Outcomes
SS5 Draw and interpret top, front and side views of 3-D objects composed of right rectangular prisms.

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, 9a), b), *or* c), Math Link
Extension/Enrichment	1, 2, 3a), b), *or* c), 8–11, 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 with a communication activity involving 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 is being described. Afterward, have students compare the drawing with the picture. As a class, discuss how students could improve their communication. Emphasize the importance of using a common mathematical language.


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

I used ten blocks.
Sable, what does yours look like if you look at it from the top?

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*.
Face: flat or curved surface
Edge: line segment where two faces meet
Vertex: point where three or more edges meet

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?

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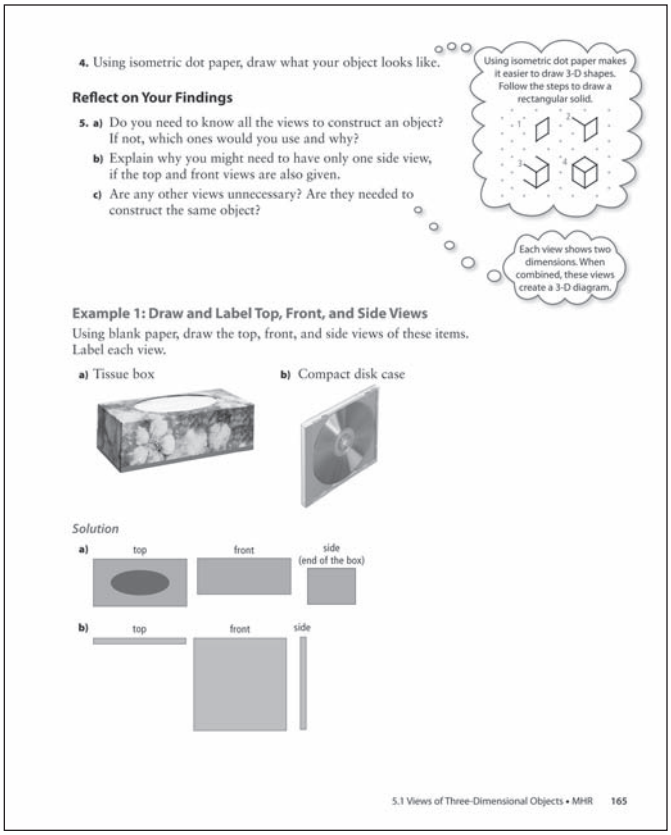
Literacy Link Use the Literacy Link on page 164 to help explain the terms *face*, *edge*, and *vertex*.

Explore the Math

This activity follows directly from the communication activity described above. Have students work on the exploration in pairs and discuss their answers. Give each pair of students a supply of unit blocks. They will also need isometric dot paper in order to complete #4.


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

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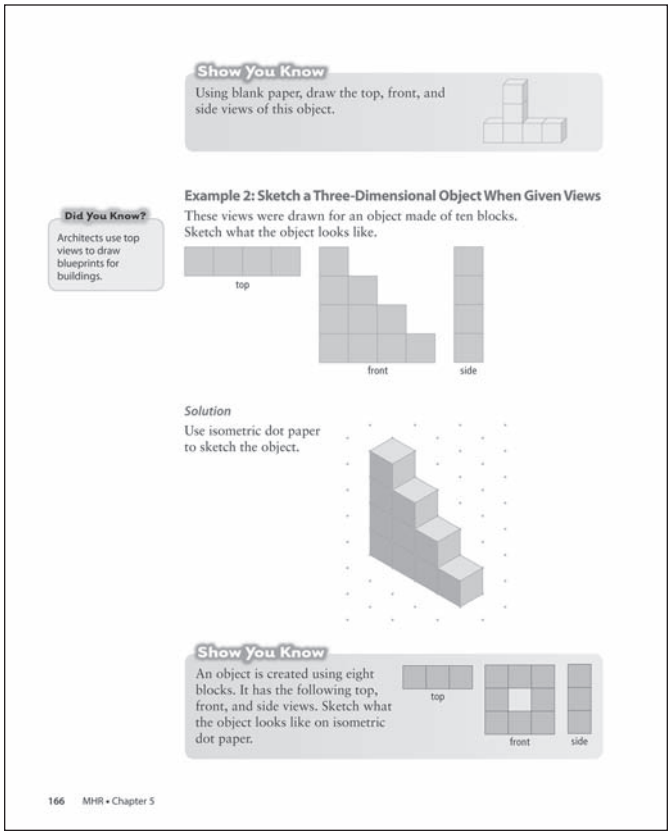
Show You Know

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

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

Did You Know?

Architects use top views to draw blueprints for buildings.

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

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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 use **Master 7 Isometric Dot Paper** to complete the Show You Know.

Example 2

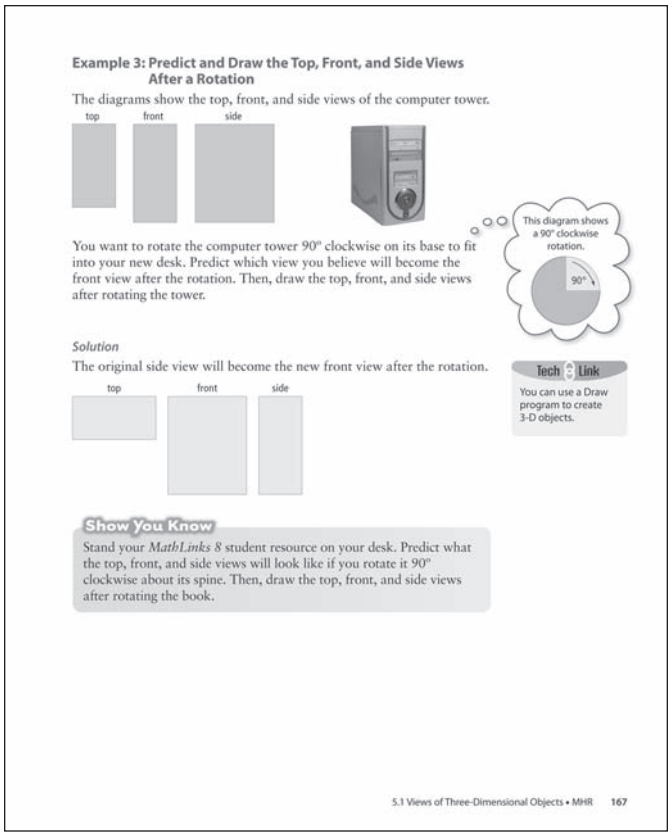
Some students may benefit from having a rectangular prism, such as a cardboard box, available to demonstrate the actual rotation. Make sure to begin with the same top, front, and side views as those shown in the student resource.

Example 3

Have students practise drawing the views of the computer tower after the rotation on isometric dot paper, then have them complete the Show You Know on the same sheet of paper.

Meeting Student Needs

- You may need to coach some students in using isometric dot paper to draw an object. Work only with individuals who are having difficulty. Use the thought bubble on page 165 to demonstrate how to draw connected cubes on this type of paper.
- 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 students first construct the object out of unit blocks, then draw it.
- Have students work with a partner 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 3, construct an object from unit blocks and have students verbally label the top, front, and sides of the object. Ask 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.



Example 3: Predict and Draw the Top, Front, and Side Views After a Rotation

The diagrams show the top, front, and side views of the computer tower.

top front side

You want to rotate the computer tower 90° clockwise on its base to fit into your new desk. Predict which view you believe will become the front view after the rotation. Then, draw the top, front, and side views after rotating the tower.

Solution

The original side view will become the new front view after the rotation.

top front side

Tech Link

You can use a Draw program to create 3-D objects.

Show You Know

Stand your *MathLinks 8* student resource on your desk. Predict what the top, front, and side views will look like if you rotate it 90° clockwise about its spine. Then, draw the top, front, and side views after rotating the book.

ELL

- Discuss the meaning of *rotation* and *clockwise*. Help students recall the number of degrees in a circle and discuss how far around the circle 90°, 180°, 270°, and 360° are. Have students stand up and rotate the specified number of degrees as you call them out.
- Have students work in pairs for the Explore the Math so they can clearly understand the importance of using common mathematical language to describe 3-D objects.

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).

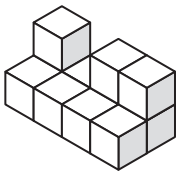
Web Link

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. Objects will vary. Example:

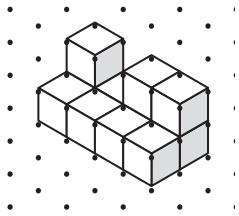


2. Answers may vary. Example: It looks like a park bench with four seats, where the second seat from the left does not have a back. The number four was helpful.

3. Answers may vary. Examples:
- From the front, you see two rows of four blocks, with the second block from the left missing in the upper row.
- From the left side, you see three blocks arranged in the shape of the capital L.

Yes, it was easier to describe the object by referring to the front and left-side faces.

4. Drawings will vary. Example:



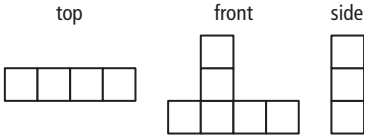
5. a) No, the top, front, and side views are usually sufficient to describe an object.

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

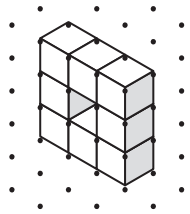
c) The bottom and the back views are unnecessary. They are, respectively, identical to or opposites of the top and front views.

Answers

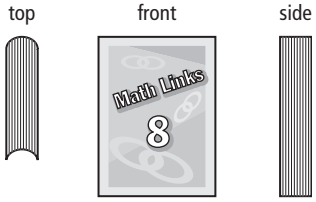
Show You Know: Example 1



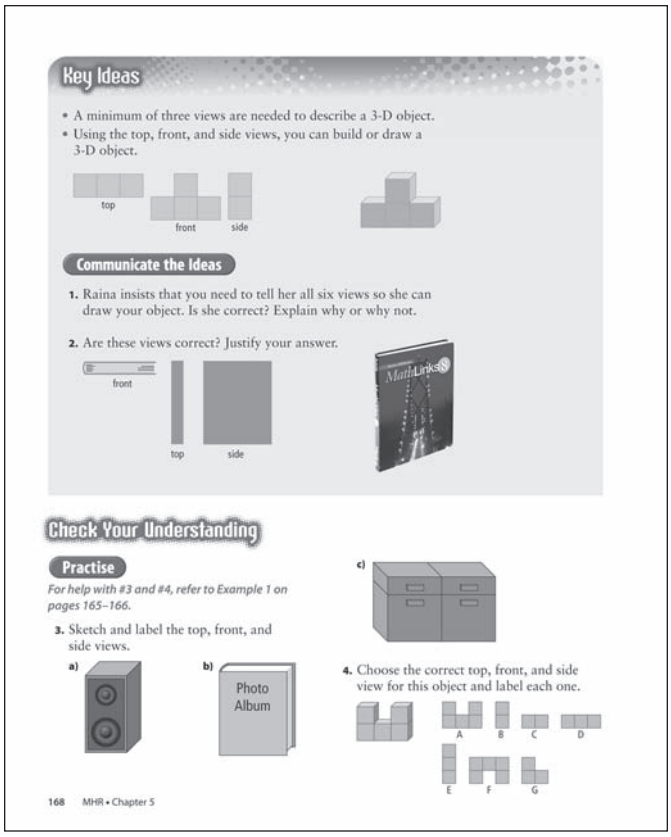
Show You Know: Example 2



Show You Know: Example 3



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.	• Students may benefit from looking at the top and the bottom of the object. Ask students: Are they the same? Are the front and the back the same? • Have students trace some of the faces on 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 with a partner. • Students may benefit from having you work through one view to help them begin, and then finish the remaining two views on their own. • 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 such as this one to check for understanding. 
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 to build the object out of unit blocks to help them draw the object, or to trace and cut out the pieces, putting them back together with tape. • Some students may benefit from building the object to show their understanding instead of drawing it on isometric dot paper. Alternatively, assist students with their drawings.
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. • For consistency, make sure all students use the front cover of the student resource as the front view. If not, consider all the different possible answers.



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

MathLinks 8

Check Your Understanding

Practise

For help with #3 and #4, refer to Example 1 on pages 165–166.

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

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Communicate the Ideas

These questions give 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 student resource.

Answers

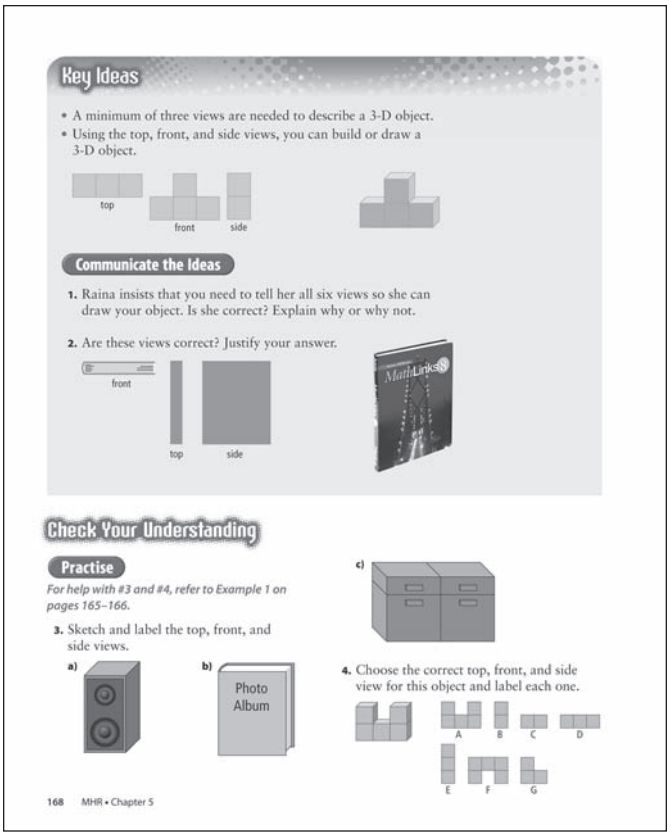
Communicate the Ideas

1. No, three views (top, front, and side) are sufficient to draw the object.
2. Answers may vary. Example: The views are labelled incorrectly. The front should be the top, the top should be the side, and the side should be the front.

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 object with the object itself in the Key Ideas section, then work on #2.

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.	• Some students may benefit from discussing the answer to #1 and #2 with a classmate, and then recording 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 object.



Key Ideas

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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.
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front top side

Check Your Understanding

Practise

For help with #3 and #4, refer to Example 1 on pages 165–166.

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

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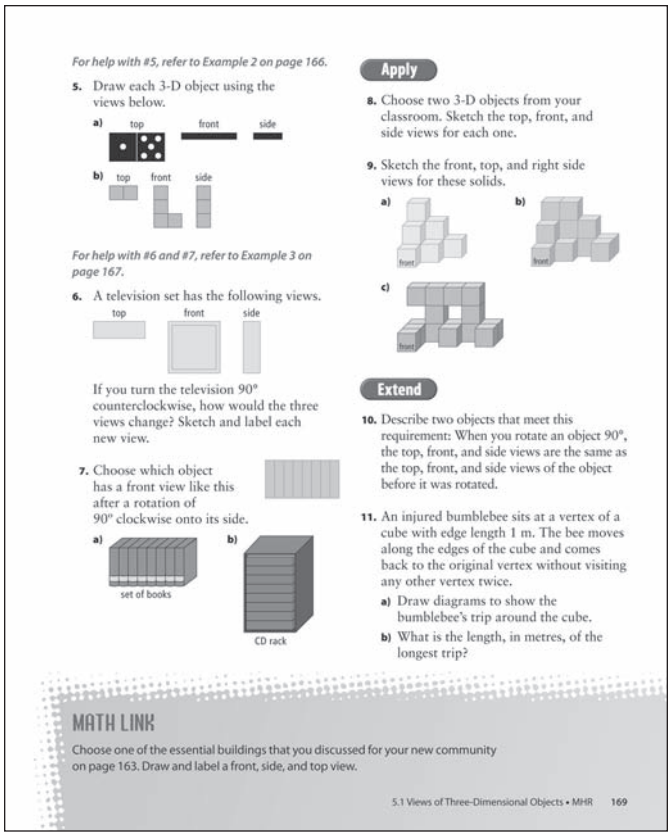


For help with #5, refer to Example 2 on page 166.

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 167.

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 an object 90°, the top, front, and side views are the same as the top, front, and side views of the object before it was 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 163. Draw and label a front, side, and top view.

5.1 Views of Three-Dimensional Objects • MHR 169

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 *counterclockwise* means rotating to the left.

Apply

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

You may wish to build #9a) 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 part b) individually, then compare it to the actual 3-D object built from unit blocks.

Extend

You may wish to have various shapes available in the classroom for #10.

Students may find it helpful to have a unit block when doing #11.

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 from their discussions in the chapter opener.

Encourage students to use only one object to represent the shape of their building, not combined objects. Consider having students share their drawings with the class.

Meeting Student Needs

- For #6, some students may benefit from trying the rotation with their student resource first, verbalizing how the shape changes after the rotation.
- Provide students with unit blocks to manipulate in order to help them draw the top, front, and side views of 3-D objects.
- Provide **BLM 5–6 Section 5.1 Extra Practice** to students who would benefit from more practice.

Gifted and Enrichment

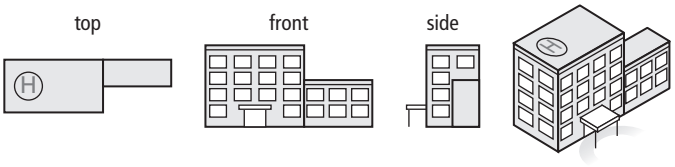
- Have students research and create a poster of 3-D objects that are commonly found in their community or culture (e.g., Aboriginal drums, boxes for ceremonial objects, artifacts).

Answers

Math Link

Drawings will vary. Look for the following:
- accurate front, side, and top view of the building
- accurate labels for the building

Example:



Assessment	Supporting Learning
Assessment *for* Learning	
Practise and Apply 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 rest of the Apply questions.	• For #3, encourage students who are concrete or kinesthetic learners to use their student resource or a box in the classroom. Encourage them to trace the sides and label them. Have them try #3b) before going on. • Students may wish to use blocks to complete #4 on a smaller scale. Ask students to verbalize what they see before trying #4 again. • For #5, provide students with unit blocks to manipulate in order to help them draw each 3-D object. • 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 view, cutting it out, and taping the pieces together in order to see the 3-D object it creates. Have students verbally explain #7b). Ask them to describe how the top and front view given fit together.
Math Link The Math Link on page 169 is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page 191.	• 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 benefit from suggestions for choosing an essential building or determining what their chosen building might look like (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 complete the statements. • 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.