7 Volume

General Outcomes

- Use direct or indirect measurement to solve problems.

Specific Outcomes

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

By the end of this chapter, students will be able to:

Section	Understanding Concepts, Skills, and Processes
7.1	✓ explain the meaning of volume
	✓ determine the volume of a right rectangular prism, right triangular prism, and right cylinder
	✓ show that orientation does not affect volume
7.2	✓ use a formula to determine the volume of a right rectangular prism
	✓ use a formula to determine the volume of a right triangular prism
7.3	✓ use a formula to determine the volume of a cylinder
7.4	✓ solve problems involving right rectangular prisms, right triangular prisms, and right cylinders

Assessment	Supporting Learning
Assessment *for* Learning	
Method 1: Use the Math Link introduction on page 245 in *MathLinks 8* to activate student prior knowledge about the skills and processes that will be covered in this chapter. **Method 2:** Have students develop a journal to explain what they personally know about volume.	• **BLM 7–1 Chapter 7 Math Link Introduction** provides scaffolding for the Math Link introduction. • Have students use the What I Need to Work On section of their chapter Foldable to keep track of the skills and processes that need attention. They can check off each item as they develop the skill or process at an appropriate level. • Students who require activation of prerequisite skills may wish to complete the Get Ready materials available on **BLM 7–2 Chapter 7 Get Ready**, in the *MathLinks 8 Practice and Homework Book*, and at the www.mathlinks8.ca book site.
Assessment *as* Learning	
Literacy Link (page 243) Have students develop a VVC for each key term listed on page 243. This can be done at the beginning of the chapter or as each term is introduced throughout the chapter.	• Encourage students to use the glossary on pages 517–521 to help them. • Students who computerize their VVCs may wish to access the *MathLinks 8* online glossary by going to www.mathlinks8.ca and following the links. • Brainstorm ideas for the How I Will Remember It box for each term. Record the ideas on an overhead or chart paper. Encourage students to use these as springboards for developing ones of their own.
Chapter 7 Foldable As students work on each section in Chapter 7, have them keep track of any problems they are having in the What I Need to Work On section of their chapter Foldable.	• As students complete each section, have them review the list of items they need to work on and check off any that have been handled.
Assessment *for* Learning	
BLM 7–3 Chapter 7 Warm-Up This BLM includes four warm-ups, one to be used at the beginning of each section. Each warm-up provides cumulative review questions for the entire student resource to that point, as well as mental math practice.	• As students complete questions from previous chapters, note which skills they are retaining and which ones may need additional reinforcement. • Use the warm-up to provide additional opportunities for students to demonstrate their understanding of the chapter material. • Have students share their strategies for completing mental math calculations.

Problems of the Week

Have all students try at least one of the problems on **BLM 7–4 Chapter 7 Problems of the Week**. Many of these problems require students to think outside the box and experiment with a variety of approaches. Some have definitive answers; others can be answered in more than one way.

Students can take the problems home and consult with parents or guardians, work with other students when their work is completed, or try them on their own. The questions take different amounts of time to solve, depending on the particular student and the problem itself. You may wish to give out these problems at the beginning of the chapter and discuss the solutions at appropriate times throughout your work on the chapter.

Meeting Student Needs

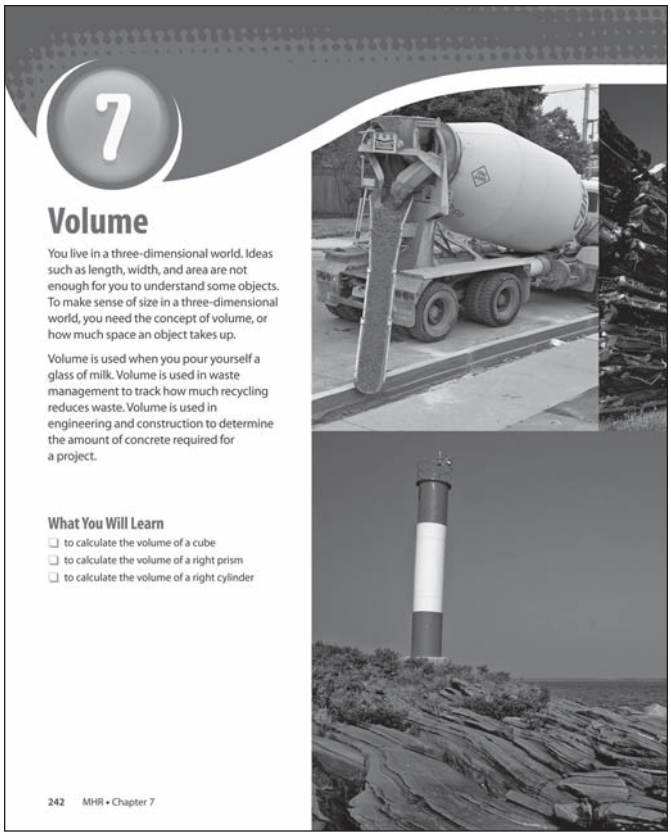
- Note that #1 and #5 require students to distinguish between area and volume.

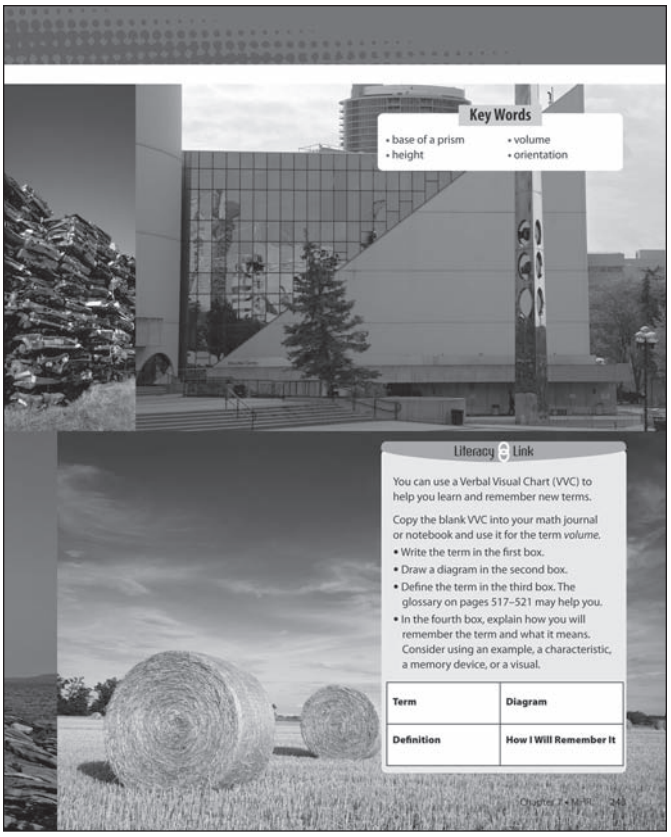
Gifted and Enrichment

- In #3, challenge students to check whether a cylinder with a shorter height always has a greater volume. Does a shorter side on a piece of paper when rolled into a cylinder always have more volume than a longer side? When would the cylinders be of equal volume? (Volume will always be greater on the shorter height. Volume would be equal if the paper were in the shape of a square.)

Chapter 7 Planning Chart

Section/ Suggested Timing	Prerequisite Skills	Materials/Technology	Teacher's Resource Blackline Masters	Exercise Guide	Extra Support	Assessment		
						Assessment *as* Learning	Assessment *for* Learning	Assessment *of* Learning
Chapter Opener • 40–50 minutes (TR page 333)	Students should be familiar with • differentiating between 2-D shapes and 3-D objects	• two sheets of 11 × 17 paper • ruler • stapler • scissors (optional) • large index cards (or several sheets of notebook paper cut into quarters)	BLM 7–1 Chapter 7 Math Link Introduction BLM 7–2 Chapter 7 Get Ready BLM 7–4 Chapter 7 Problems of the Week		Online Learning Centre	TR page 332 Chapter 7 Foldable, TR page 332	TR page 332	
7.1 Understanding Volume • 80–100 minutes (TR page 337)	Students should be familiar with • determining the area of a rectangle, triangle, and circle • determining the surface area of right rectangular prisms, right triangular prisms, and right cylinders	• models of right rectangular prisms, right triangular prisms, and right cylinders • ruler • centimetre cubes • calculator (optional)	Master 2 Two Stars and One Wish Master 8 Centimetre Grid Paper BLM 7–3 Chapter 7 Warm-Up BLM 7–5 Section 7.1 Extra Practice BLM 7–6 Section 7.1 Math Link	**Essential:** 1, 2, 3a), b), 4a), b), 5, 7, 8, Math Link **Typical:** 1, 2, 3a), b), 4a), b), 5, 7–13, Math Link **Extension/Enrichment:** 1, 2, 13–18, Math Link	*MathLinks 8 Practice and Homework Book* *MathLinks 8 Solutions Manual*	Master 2 Two Stars and One Wish TR pages 341, 343 Math Learning Log, TR page 345 Chapter 7 Foldable, TR page 345	TR pages 341, 345	
7.2 Volume of a Prism • 80–100 minutes (TR page 346)	Students should be familiar with • determining the volume of a prism using area of base × height of prism	• models of right rectangular prisms and right triangular prisms • calculator (optional) • centimetre cubes (optional)	Master 6 Square Dot Paper Master 7 Isometric Dot Paper Master 8 Centimetre Grid Paper BLM 7–3 Chapter 7 Warm-Up BLM 7–7 Section 7.2 Extra Practice BLM 7–8 Section 7.2 Math Link	**Essential:** 1–4, 5a), b), 7a), b), 8a), b), 9, Math Link **Typical:** 1–4, 5a), b), 7a), b), 8a), b), 9, 11–15, Math Link **Extension/Enrichment:** 1–3, 11, 12, 15–24, Math Link	*MathLinks 8 Practice and Homework Book* *MathLinks 8 Solutions Manual*	TR pages 349, 351 Math Learning Log, TR page 354 Chapter 7 Foldable, TR page 354	TR pages 349, 354	
7.3 Volume of a Cylinder • 80–100 minutes (TR page 355)	Students should be familiar with • determining the area of a circle • determining the volume of a cylinder using area of base × height of cylinder	• ruler • a variety of empty cylindrical cans (one per pair of students) • centimetre grid paper • measuring cup (one per pair of students) • sand or rice • calculator • construction paper (optional) • transparent tape (optional) • dime (optional) • models of right prisms, cubes, and right cylinders	Master 8 Centimetre Grid Paper BLM 7–3 Chapter 7 Warm-Up BLM 7–9 Section 7.3 Extra Practice BLM 7–10 Section 7.3 Math Link	**Essential:** 1, 3, 4a), b), 5a), d), 6a), b), 7a), b), 8, Math Link **Typical:** 1, 3, 4a), b), 5a), d), 6a), b), 7a), b), 8, 10, 12–14, Math Link **Extension/Enrichment:** 1, 3, 11, 12, 15–18, Math Link	*MathLinks 8 Practice and Homework Book* *MathLinks 8 Solutions Manual*	TR pages 358, 360 Math Learning Log, TR page 362 Chapter 7 Foldable, TR page 362	TR pages 358, 362	
7.4 Solving Problems Involving Prisms and Cylinders • 80–100 minutes (TR page 363)	Students should be familiar with • determining the volume of prisms and cylinders	• centimetre cubes • centimetre grid paper • ruler • transparent strips (optional) • calculator • rolled up newspaper or magazine (optional) • modelling clay (optional) • tape measure (optional)	Master 8 Centimetre Grid Paper BLM 7–3 Chapter 7 Warm-Up BLM 7–11 Section 7.4 Extra Practice BLM 7–12 Section 7.4 Math Link	**Essential:** 1–7, Math Link **Typical:** 1–5, 7, 9–11, 13, 14, Math Link **Extension/Enrichment:** 1, 2, 14–21, Math Link	*MathLinks 8 Practice and Homework Book* *MathLinks 8 Solutions Manual*	TR pages 366, 368 Math Learning Log, TR page 371 Chapter 7 Foldable, TR page 371	TR pages 367, 371	
Chapter 7 Review • 40–50 minutes (TR page 372)		• ruler • centimetre cubes (optional) • calculator	BLM 7–5 Section 7.1 Extra Practice BLM 7–7 Section 7.2 Extra Practice BLM 7–9 Section 7.3 Extra Practice BLM 7–11 Section 7.4 Extra Practice	Have students do at least one question related to any concept, skill, or process that has been giving them trouble.	*MathLinks 8 Practice and Homework Book* *MathLinks 8 CAB*	Chapter 7 Foldable, TR page 372	TR page 373	
Chapter 7 Practice Test • 40–50 minutes (TR page 374)		• ruler • calculator • prisms and cylinders (e.g., cereal boxes, cans)	BLM 7–13 Chapter 7 Test	Provide students with the number of questions they can comfortably do in one class. Choose at least one question for each concept, skill, or process. **Minimum:** 1, 2, 4–6, 8, 11, 13	*MathLinks 8 CAB*	TR page 375		TR page 375 BLM 7–13 Chapter 7 Test
Chapter 7 Wrap It Up! • 80–100 minutes (TR page 376)		• ruler • calculator	Master 1 Project Rubric BLM 7–1 Chapter 7 Math Link Introduction BLM 7–6 Section 7.1 Math Link BLM 7–8 Section 7.2 Math Link BLM 7–10 Section 7.3 Math Link BLM 7–12 Section 7.4 Math Link BLM 7–14 Chapter 7 Wrap It Up!		Online Learning Centre			TR page 376 Master 1 Project Rubric
Chapter 7 Math Games • 20–30 minutes (TR page 378)		• deck of playing cards per pair or small group • calculator					TR page 378	
Chapter 7 Challenge in Real Life • 80–100 minutes (TR page 379)		• sample storage boxes (optional) • ruler	Master 1 Project Rubric Master 7 Isometric Dot Paper Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 7–15 Chapter 7 BLM Answers		Online Learning Centre		TR page 380	TR page 380 Master 1 Project Rubric





***MathLinks 8*, pages 242–245**

Suggested Timing
40–50 minutes

Materials
- two sheets of 11 × 17 paper
- ruler
- stapler
- large index cards (or several sheets of notebook paper cut into quarters)
- scissors (optional)

Blackline Masters
BLM 7–1 Chapter 7 Math Link Introduction
BLM 7–2 Chapter 7 Get Ready
BLM 7–4 Chapter 7 Problems of the Week

Key Words

base of a prism	volume
height	orientation

What's the Math?

In this chapter, students extend their knowledge of two-dimensional area to the concept of three-dimensional volume. Students explore the relationship between area and volume by using familiar shapes and objects to reach a generalization about the relationship. Students use this generalization to understand and use formulas for determining the volume of cubes, right rectangular prisms, right triangular prisms, and right cylinders. Students then practise solving problems involving right rectangular prisms, right triangular prisms, and right cylinders.

Planning Notes

Before starting Chapter 7, explain that this chapter will continue the exploration of geometry that students began in Chapter 5. Briefly have students recall what they learned about calculating the area of triangles, circles, and rectangles, and the surface area of right rectangular prisms, right triangular prisms, and right cylinders.

Review the term *right* with reference to 3-D objects. Have students point out 3-D objects in the classroom, and differentiate among right rectangular prisms, right triangular prisms, and right cylinders. Point out any shapes that are not right shapes, that is, the side faces are not perpendicular to the base face, such as a foam coffee cup (more of a conical shape), a wastepaper basket, or a four-sided die. This could be set up like a scavenger hunt in which each group finds one of each right shape and three shapes that are not right.

Remind students that, in right prisms and right cylinders, the sides are perpendicular to the base. Stress that in this case, right does not mean correct or refer to a right triangle.

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 7, have students write down what they already know about *volume*. You may wish to have them revise their VVC at the end of section 7.1.

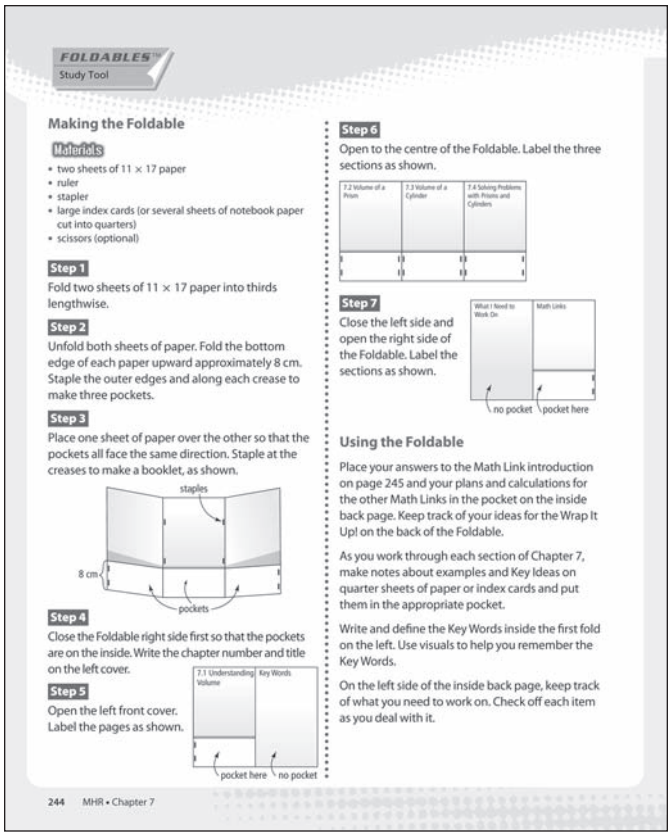
Work as a class to develop a memory device for remembering the difference between *volume* and *area*.

Meeting Student Needs

- Help students recall what they know about geometry before beginning this chapter. Consider having them complete the questions on **BLM 7–2 Chapter 7 Get Ready** to activate the prerequisite skills for this chapter.
- Some students may benefit from recalling the formulas for calculating the area of a rectangle, a triangle, and a circle.
- Students have different abilities in understanding the idea of spatial sense, so some students may benefit from using manipulatives throughout the chapter. When discussing the concept that any face of a rectangular prism can be used as a base to determine volume, consider using a prism with each face painted a different colour (use blocks of wood of different shapes). This will make it easier to refer to the different faces.
- Have students use small cards for their VVCs. By making a VVC for each important word in the chapter, they can develop a small deck of cards 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, and association for each Key Term.

ELL

- Clarify terms such as *volume*, *waste management*, *recycling*, *engineering*, *construction*, and *concrete*.
- English language learners may have difficulty with geometry vocabulary such as *volume*, *orientation*, *base*, *face*, *right prism*, *right rectangular prism*, *right triangular prism*, *right cylinder*, *vertex*, *edge*, and *perpendicular*. Have students complete some or all of the following activities to help reinforce these vocabulary terms: match vocabulary to pictures of terms (such as for a memory or concentration game); unscramble the terms in a scrambled letters activity; match definitions to terms; and add definitions and illustrations of new terms to their dictionary. Concrete and kinesthetic learners may benefit from building and labelling toothpick models of a right triangular prism and a right rectangular prism.



FOLDABLES™
Study Tool

Making the Foldable

Materials
- two sheets of 11 × 17 paper
- ruler
- stapler
- large index cards (or several sheets of notebook paper cut into quarters)
- scissors (optional)

Step 1
Fold two sheets of 11 × 17 paper into thirds lengthwise.

Step 2
Unfold both sheets of paper. Fold the bottom edge of each paper upward approximately 8 cm. Staple the outer edges and along each crease to make three pockets.

Step 3
Place one sheet of paper over the other so that the pockets all face the same direction. Staple at the creases to make a booklet, as shown.

staples
8 cm
pockets

Step 4
Close the Foldable right side first so that the pockets are on the inside. Write the chapter number and title on the left cover.

Step 5
Open the left front cover. Label the pages as shown.

7.1 Understanding Volume | Key Words
pocket here | no pocket

Step 6
Open to the centre of the Foldable. Label the three sections as shown.

7.2 Volume of a Prism | 7.3 Volume of a Cylinder | 7.4 Solving Problems with Prisms and Cylinders

Step 7
Close the left side and open the right side of the Foldable. Label the sections as shown.

What I Need to Work On | Math Links
no pocket | pocket here

Using the Foldable

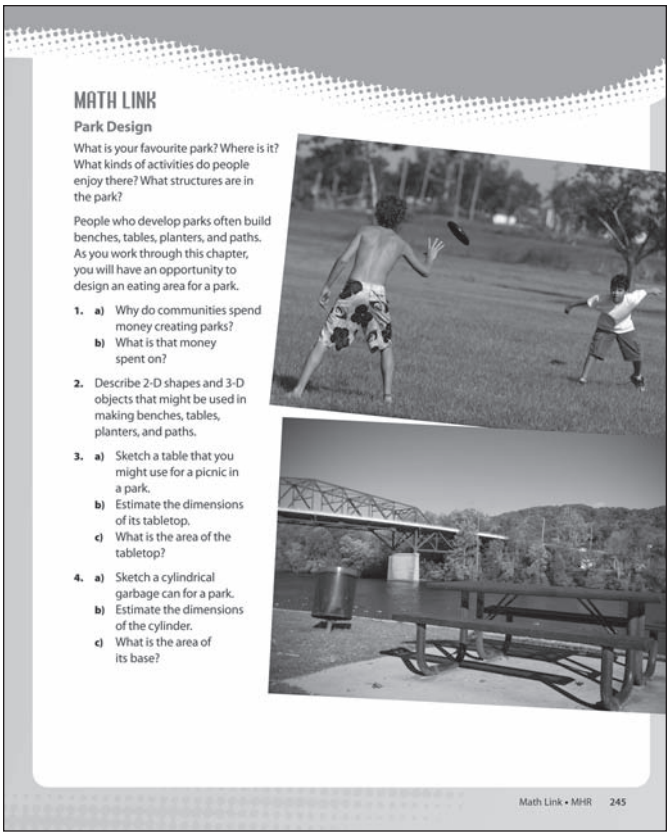
Place your answers to the Math Link introduction on page 245 and your plans and calculations for the other Math Links in the pocket on the inside back page. Keep track of your ideas for the Wrap It Up! on the back of the Foldable.

As you work through each section of Chapter 7, make notes about examples and Key Ideas on quarter sheets of paper or index cards and put them in the appropriate pocket.

Write and define the Key Words inside the first fold on the left. Use visuals to help you remember the Key Words.

On the left side of the inside back page, keep track of what you need to work on. Check off each item as you deal with it.

244 MHR • Chapter 7



MATH LINK

Park Design

What is your favourite park? Where is it? What kinds of activities do people enjoy there? What structures are in the park?

People who develop parks often build benches, tables, planters, and paths. As you work through this chapter, you will have an opportunity to design an eating area for a park.

1. a) Why do communities spend money creating parks?
   b) What is that money spent on?
2. Describe 2-D shapes and 3-D objects that might be used in making benches, tables, planters, and paths.
3. a) Sketch a table that you might use for a picnic in a park.
   b) Estimate the dimensions of its tabletop.
   c) What is the area of the tabletop?
4. a) Sketch a cylindrical garbage can for a park.
   b) Estimate the dimensions of the cylinder.
   c) What is the area of its base?

Math Link • MHR 245

Foldables Study Tool

Have students make the Foldable in the student resource to keep track of the information in the chapter.

Have students record their work for the Math Link introduction and the calculations for the section Math Links on pages 253, 261, 267, and 275 in the pocket on the back page on the right of their chapter Foldable. Have them keep track of their ideas for the Wrap It Up! on the back of their chapter Foldable. As students work through each section of Chapter 7, have them keep notes about examples and Key Ideas on index cards and put them in the appropriate pocket. Have students write and define the Key Words inside the first fold on the left of their chapter Foldable. On the page inside the fold on the right, have them keep track of what they need to work on. Have students check off each item as they deal with it.

Have students store their chapter Foldable in a binder. You may wish to provide them with a plastic envelope that fits into their binder for this purpose.

Math Link

Before beginning this chapter, consider asking students to visit a local park and draw or photograph geometric shapes in the park. Read the Math Link introduction on page 245 as a class and ask students to describe the park they visited. Have students use their drawings and photos and work in small groups to identify geometric shapes in a park. By activating their prior knowledge within the context of the Math Link, students will have a context in which to connect their learning throughout the chapter.

Have students read the Wrap It Up! problem on page 279 to give them a sense of where the Math Link is heading. The Wrap It Up! problem is a summative assessment. As students work through the chapter, they need to complete the related Math Links in sections 7.1, 7.2, 7.3, and 7.4. These Math Links will assist them in doing the Wrap It Up! problem.

Meeting Student Needs

- Consider creating the chapter Foldable ahead of time to use as a model.
- Parks are uncommon in the North. However, indoor playgrounds have been built for children in some communities. As an alternative scenario, ask students to help design a new family activity centre for their community. This centre would have playground facilities for younger children, an area for youth activities, and a meeting place for families to sit, converse, and eat. Have them address the following questions: Where would you locate the centre in the community? Is there an existing building that could be used? What kinds of activities would families enjoy there? Then, have students use the scenario to answer the questions in the Math Link introduction on page 245.
- To help them to get started, some students may benefit from using **BLM 7–1 Chapter 7 Math Link Introduction**, which provides scaffolding for this activity.

ELL

- Help English language learners who may have difficulty with terms such as *park*, *structures*, *benches*, *planters*, *dimensions*, and *garbage can* by orally explaining these terms in context and providing pictures where appropriate. Have students add any new terms to their dictionary.

Answers

Math Link

1. a) Answers will vary. Communities spend money on parks to provide places for recreation for their citizens.

b) Answers will vary. The money is spent on playground equipment, picnic tables, waste receptacles, sports nets, and maintenance.

2. Answers will vary. Example:
- 2-D shapes such as squares, rectangles, and circles
- 3-D objects such as cubes, prisms, and cylinders

3. a) Sketches will vary. Ensure that sketches are reasonable.

b) Look for reasonable dimensions for the table top such as 1 m × 1 m or 1 m × 1.5 m.

c) Answers will vary depending on part b).

4. a) Sketches will vary. Ensure that sketches are reasonable.

b) Look for a reasonable radius such as approximately 0.3 m.

c) Answers will vary. Example: The area of a base with radius 0.3 m is 0.28 m^2.