Volume and Surface Area

Key Terms

cone
cylinder
prism
pyramid
sphere
surface area
volume

Chapter Curriculum Specific Expectations
Solving Problems Involving Surface Area and Volume, Using the Imperial and Metric Systems of Measurement

In this chapter, students will

MT3.01 use the imperial system when solving measurement problems (e.g., problems involving dimensions of lumber, areas of carpets, and volumes of soil or concrete)

MT3.02 perform everyday conversions between the imperial system and the metric system (e.g., millilitres to cups, centimetres to inches) and within these systems (e.g., cubic metres to cubic centimetres, square feet to square yards), as necessary to solve problems involving measurement

MT3.03 determine, through investigation, the relationship for calculating the surface area of a pyramid (e.g., use the net of a square-based pyramid to determine that the surface area is the area of the square base plus the area of the four congruent triangles)

MT3.04 solve problems involving the surface areas of prisms, pyramids, and cylinders, and the volumes of prisms, pyramids, cylinders, cones, and spheres, including problems involving the combinations of these figures, using the metric system or the imperial system, as appropriate

Teaching Suggestions
Chapter Opener
• As a class, read about the real-world applications of calculating volume and surface area in the Chapter Opener. Have students brainstorm how they would measure the volume of a storage tank and the surface area of a tower.
• Encourage students to think of other applications of surface area and volume by prompting them to think of jobs that require applying these concepts (e.g., contractor needs to calculate the surface area of walls in order to buy drywall).

Literacy Link
• Have students start a discussion chart. You may wish to have students use **BLM 9.CO.1 Literacy Link: Discussion Chart** for this activity.
• Consider having students discuss the main ideas at the end of each section, or review all the main ideas during the Chapter Review.
• Remind students to use the Key Terms to help them complete the Discussion Chart.
• For more information on the Think Literacy program, visit http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy.

Career Profile

- Help students relate to the skills a computer graphic artist uses by asking them about the skills they use to design a title page. Ask them about challenges (e.g., adjusting font size of letters to fit words in a limited space). Emphasize that planning the size and shape of text and visuals helps create a better final product.
- Consider having students use the Internet to research careers that require applying knowledge about surface area and volume. Or, some students might research related programs such as graphic design, computer animation, or fashion offered at a local college. Have students present their findings in an oral report and discuss:
  - What someone who pursues the career does
  - What careers are similar
  - What the education and training involve
- You may wish to use **BLM A11 Presentation Checklist** to assess the reports.
- Have students add their research to their Portfolios.

Chapter 9 Planning Chart

Section Suggested Timing	Student Text Page(s)	Teacher's Resource Blackline Masters	Assessment	Tools
Chapter 9 Opener • 20–30 min	360–361	• BLM 9.CO.1 Literacy Link: Discussion Chart	• BLM A11 Presentation Checklist	
Get Ready! • 80 min	362–363	• BLM 9.GR.1 Practice: Get Ready • BLM 9.GR.3 Nets	• BLM 9.GR.2 Get Ready Self-Assessment Checklist	• calculators • chart paper and markers • scissors • tape
9.1 Volume of Prisms and Pyramids • 80–160 min	364–371	• BLM 9.1.1 Practice: Volume of Prisms and Pyramids • BLM 9.1.2 Investigate: Compare the Volume of a Prism and a Pyramid • BLM G1 Grid Paper • BLM G3 Centimetre Grid Paper	• BLM 9.1.3 Achievement Check Rubric • BLM A3 Communication General Scoring Rubric	• calculators • cardstock paper (optional) • goggles (optional) • modelling clay (optional) • nets of prisms and pyramids with congruent bases and equal heights (optional) • rulers • sand • scissors • sheets of clear acetate • tape • toothpicks or straws (optional)
9.2 Surface Area of Prisms and Pyramids • 80–160 min	372–380	• BLM 9.2.1 Practice: Surface Area of Prisms and Pyramids • BLM 9.2.2 Formula Sheet • BLM G1 Grid Paper		• calculators • cardstock paper (optional • grid paper • rulers • scissors (optional) • several rolls of wrapping paper (optional) • tape (optional)
9.3 Surface Area and Volume of Cylinders • 80–160 min	381–390	• BLM 9.3.1 Practice: Surface Area and Volume of Cylinders • BLM 9.2.2 Formula Sheet		• calculators • cardstock paper (optional) • paper tubes of various sizes • scissors • sheets of paper • skateboard wheels (optional) • tape (optional)
9.4 Volume of Cones and Spheres • 80–160 min	391–397	• BLM 9.4.1 Practice: Volumes of Cones and Spheres • BLM 9.4.2 Investigate: Compare the Volume of a Cylinder and a Cone • BLM 9.2.2 Formula Sheet		• calculators • nets of a cylinder and cone (optional) • rulers • sand • scissors • sheets of clear acetate • sheets of paper (optional) • tape
9.5 Solve Problems Involving Surface Area and Volume • 80–160 min	398–405	• BLM 9.5.1 Practice: Solve Problems Involving Surface Area and Volume • BLM 9.5.2 Investigate: Surface Area and Volume of a Composite Solid • BLM 9.2.2 Formula Sheet • BLM G1 Grid Paper	• BLM 9.5.3 Achievement Check Rubric	• building blocks • calculators • magazines • paper • scissors • tape

Section Suggested Timing	Student Text Page(s)	Teacher's Resource Blackline Masters	Assessment	Tools
Chapter 9 Review • 80 min	406–407	• BLM 9.CR.1 Chapter 9 Review		• calculators
Chapter 9 Practice Test • 80 min	408–409	• BLM G1 Grid Paper	• BLM 9.PT.1 Chapter 9 Practice Test • BLM 9.CT.1 Chapter 9 Test	• calculators
Chapter 9 Problem Wrap-Up • 15–20 min	409		• BLM 3.CP.1 Chapter 3 Problem Wrap-Up Rubric	• calculators
Task: Design a Game • 80–160 min	410–411	• BLM G1 Grid Paper	• BLM 9.T.1 Task: Design a Game Rubric	• Bristol board • calculators • coloured pencils or markers • graphing calculators • grid paper • index cards • scissors • tape
Chapters 1 to 9 Review • 80 min	412–415	• BLM G1 Grid Paper	• BLM A9 Self-Assessment Recording Sheet • BLM A16 Self-Assessment Checklist	• graphing calculators • grid paper

Chapter 9 Blackline Masters Checklist

		Title	Purpose
Chapter 9 Opener			
	BLM 9.CO.1	Literacy Link: Discussion Chart	Literacy
	BLM A11	Presentation Checklist	Assessment
Get Ready!			
	BLM 9.GR.1	Practice: Get Ready	Practice
	BLM 9.GR.2	Get Ready Self-Assessment Checklist	Self-Assessment
	BLM 9.GR.3	Nets	Student Support
9.1 Volume of Prisms and Pyramids			
	BLM 9.1.1	Practice: Volume of Prisms and Pyramids	Practice
	BLM 9.1.2	Investigate: Compare the Volume of a Prism and a Pyramid	Student Support
	BLM 9.1.3	Achievement Check Rubric	Assessment
	BLM A3	Communication General Scoring Rubric	Assessment
	BLM G1	Grid Paper	Student Support
	BLM G3	Centimetre Grid Paper	Student Support
9.2 Surface Area of Prisms and Pyramids			
	BLM 9.2.1	Practice: Surface Area of Prisms and Pyramids	Practice
	BLM 9.2.2	Formula Sheet	Student Support
	BLM G1	Grid Paper	Student Support
9.3 Surface Area and Volume of Cylinders			
	BLM 9.3.1	Practice: Surface Area and Volume of Cylinders	Practice
	BLM 9.2.2	Formula Sheet	Student Support
9.4 Volume of Cones and Spheres			
	BLM 9.4.1	Practice: Volumes of Cones and Spheres	Practice
	BLM 9.4.2	Investigate: Compare the Volume of a Cylinder and a Cone	Student Support
	BLM 9.2.2	Formula Sheet	Student Support
9.5 Solve Problems Involving Surface Area and Volume			
	BLM 9.5.1	Practice: Solve Problems Involving Surface Area and Volume	Practice
	BLM 9.5.2	Investigate: Surface Area and Volume of a Composite Solid	Student Support
	BLM 9.2.2	Formula Sheet	Student Support
	BLM 9.5.3	Achievement Check Rubric	Assessment
	BLM G1	Grid Paper	Student Support
Chapter 9 Review			
	BLM 9.CR.1	Chapter 9 Review	Review

		Title	Purpose
Chapter 9 Practice Test			
	BLM 9.PT.1	Chapter 9 Practice Test	Diagnostic Assessment
	BLM 9.CT.1	Chapter 9 Test	Summative Assessment
	BLM G1	Grid Paper	Student Support
Chapter 9 Problem Wrap-Up			
	BLM 9.CP.1	Chapter 9 Problem Wrap-Up Rubric	Summative Assessment
Task: Design a Game			
	BLM 9.T.1	Task: Design a Game Rubric	Assessment
	BLM G1	Grid Paper	Student Support
Chapters 1 to 9 Review			
	BLM A9	Self-Assessment Recording Sheet	Self-Assessment
	BLM A16	Self-Assessment Checklist	Self-Assessment
	BLM G1	Grid Paper	Student Support

Get Ready!

Suggested Timing
80 min

Tools
• calculators
• chart paper and markers
• scissors
• tape

Related Resources
BLM 9.GR.1 Practice: Get Ready
BLM 9.GR.2 Get Ready Self-
 Assessment Checklist
BLM 9.GR.3 Nets

Common Errors

• Some brands of calculators have the square root button as a second function to the squared button.
R_x Remind students to press the second function key first.

• Some students may not identify hypotenuse length as c in the equation $a^2 + b^2 = c^2$.
R_x Remind students that in $a^2 + b^2 = c^2$, the hypotenuse length is always c. Use an example and substitute the values into the equation to find the hypotenuse length.

• Some students may forget to use square units for area.
R_x Stress that area is always measured in square units. You might count squares on a grid to determine area of a shape, and therefore, use square units to record the units.

Teaching Suggestions

• Chapter 9 focuses on volume and surface area. Consider having students complete all of the Get Ready questions as a review of concepts needed before beginning Section 9.1.

Question 1
• Some students may have difficulty using the correct button sequence to find square roots. There is no universal sequence that works for all calculators. Have students using similar brands of calculators work together to find the button sequence that works for their calculator. Tell students to use a test question such as $x^2 = 25$ (where $x = 5$) to help determine the correct button sequence. Then, have them record the correct sequence on chart paper along with an example. Have students title the chart with the calculator brand and post it for reference.
• Model the solution for 1a) as a class, before having students complete question 1 independently.
• You may wish to use Get Ready question 1 as a diagnostic or self-assessment. If the latter, distribute **BLM 1.GR.2 Get Ready Self-Assessment Checklist**.

Question 2
• Model the solution for 2a) as a class, before having students work in groups to make the nets.
• If students are struggling, you may wish to have them cut out and tape together the nets from **BLM 9.GR.3 Nets**. You may wish to use a photocopier to enlarge the nets further.
• In advance, develop a chart of 3-D shapes and display a real example of each one. Have students refer to the chart and examples to help them answer question 2.
• You may wish to use question 2 as a diagnostic or self-assessment. If the latter, distribute **BLM 9.GR.2 Get Ready Self-Assessment Checklist** if you have not already done so.

Question 3
• You may need to review conversions, which were handled in Chapter 1. Consider posting conversion tables as a reference.
• Model the solution for 3a) before assigning students to work in pairs according to ability. Do not pair a weak student with a strong student as the stronger student may do most of the work.
• You may wish to use question 3 as a diagnostic or self-assessment. If the latter, distribute **BLM 9.GR.2 Get Ready Self-Assessment Checklist** if you have not already done so.

Question 4
• Model the solution for 4a) before having students work in pairs.
• Consider posting formulas for area as a reference. Remind students that units for area are length units squared (e.g., in.^{2}, cm^2).
• The Get Ready is an excellent form of diagnostic assessment to determine students' preparedness to move on and where remediation is necessary. The Get Ready can also be used by students for self-assessment using **BLM 9.GR.2 Get Ready Self-Assessment Checklist**.
• Use **BLM 9.GR.1 Practice: Get Ready** for extra practice or remediation.

Gifted and Enrichment—Challenge students to research and create nets for other solids they choose.

Memory—Support students who struggle with question 1 by having them solve easier problems (e.g., $x + 5 = 11$), so that they can see that after values are squared, the rearrangement is similar. The only difference is that the Pythagorean theorem involves squares and square roots.

Have students write the formulas for area for each figure in question 4 in their Discussion Chart. Allow students to use the formulas to answer questions throughout the chapter.

Perceptual—Encourage students to use calculators to check their answers to question 4.

Spatial—Encourage students to make nets using **BLM 9.GR.2 Nets**, scissors, and glue sticks to help them answer question 2.

Visual—Display the formulas for area in an easily accessible place for students.

Assessment
- Assess student readiness to proceed by informal observation as students work. A formal test would be inappropriate since this material is not part of the grade 10 curriculum for this chapter.
- Student self-assessment is also an effective technique; students can place a checkmark beside topics in the Get Ready in which they feel confident with the necessary skills. If so, have students use **BLM 1.GR.3 Get Ready Self-Assessment Checklist**.
- Provide remedial action in small groups or as a whole class skills review.

Chapter Problem
- Have students discuss their understanding of the Chapter Problem, and consider how Vanessa's problem relates to the Chapter Opener.
- The Chapter Problem questions throughout the chapter are designed to help students move toward the Chapter Problem Wrap-Up. You may wish to assign these questions as students work through each section. Alternatively, you may wish to assign the Chapter Problem questions and Chapter Problem Wrap-Up when students have completed the chapter, as part of a summative assessment.