9.3 Surface Area and Volume of Cylinders

Strand
Measurement and Trigonometry

Student Text Pages
381–390

Suggested Timing
80–160 min

Tools
- calculators
- cardstock paper (optional)
- paper tubes of various sizes
- scissors
- sheets of paper
- skateboard wheels (optional)
- tape (optional)

Related Resources
BLM 9.3.1 Practice: Surface Area and Volume of Cylinders
BLM 9.2.2 Formula Sheet

Specific Expectations

Solving Problems Involving Surface Area and Volume, Using the Imperial and Metric Systems of Measurement

In this section, 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

MT3.04 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

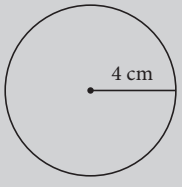
Link to Get Ready

Students will solve problems related to surface area of cylinders, including converting measurements. Have students complete questions 2, 3, and 4 of the Get Ready before proceeding with Section 9.3.

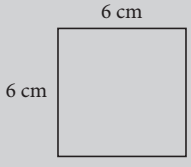
Warm-Up

1. Find the perimeter of each shape.

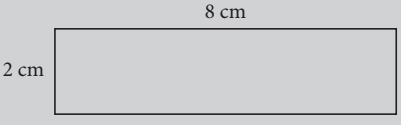
a)



b)



c)



2. Find the area of each shape in question 1.

3. Find the ratio of perimeter to area for each shape in question 1.

4. Order the ratios in question 3 from lowest to highest.

5. Draw a conclusion based on questions 3 and 4.

Warm-Up Answers

1. a) 25.12 cm **b)** 24 cm **c)** 20 cm

2. a) 50.24 cm^2 **b)** 36 cm^2 **c)** 16 cm^2

3. a) 0.5 **b)** 0.67 **c)** 1.25

4. Circle, square, rectangle

5. The more symmetric the shape, the lower the ratio. The lowest ratio is when a shape has no corners. You might explain that due to this property, a drop of oil dropped on water spreads out in a circle.

Common Errors

- Some students may confuse or forget the formulas for area and volume of cylinders.

R_x Provide students with **BLM 9.2.2 Formula Sheet** to help them.

Ongoing Assessment

- As students work on the Investigate, circulate and observe how well students work with a partner. Consider recording each student's learning skills: group work, work habits, organization, and initiative.
- Use the solutions for Practise the Concepts to assess students' understanding of surface area and volume of cylinders.
- Use Chapter Problem question 11 to assess students' ability to apply their knowledge of surface area of a cylinder.

Accommodations

ESL—Pair ESL students with those who have stronger language skills.

Gifted and Enrichment—Have students use the Internet to research the components of the International Space Station. They will likely note that a large number of components are cylindrical.

Language—Assist or have other students assist those who have trouble interpreting written instructions.

Memory—Some students may have difficulty processing the steps in multi-step problems and need some coaching. Pair such students with someone who has stronger skills. Remind students to use **BLM 9.2.2 Formula Sheet** for reference.

Motor—Students with dexterity problems could be teamed with those without such difficulties for the Investigate.

Visual—Encourage students to draw and/or label diagrams to help them solve problems.

Teaching Suggestions

Warm-Up

- Write the Warm-Up questions on the board or on an overhead. Have students complete the questions independently Then, discuss the solutions as a class. (15–20 min)
- For question 1, have students recall the name for the perimeter of a circle (circumference) and the formula ($C = \pi r^2$).
- For question 3, discuss how the smaller the ratio of perimeter to area, the more area a shape contains per unit of length in perimeter. This means that a shape with a small ratio of perimeter to area has a large area and a small amount of material is needed to enclose the area.

Section Opener

- Read the opening paragraph as a class, and discuss why a cylinder is easy to manufacture, as the material for the sides needs only to be bent into a tube and welded or riveted along the seam. Tell students that transport trucks carrying liquids tend to be cylindrical in shape so that the liquid material is easy to completely unload. Some liquid material would remain in the corners of a container shaped like a rectangular prism.

Investigate

- Review the circumference of a circle before students perform the Investigate.
- Provide students with paper tubes and scissors. Have students work with a partner and compare solutions with other pairs before taking up the solutions as a class.
- Use **BLM 9.3.1 Practice: Surface Area and Volumes of Cylinders** for extra practice or remediation.

Investigate Answers (pages 381)

1. a), b) Answers will vary depending on the dimensions of the paper tube.

3. The width of the rectangle is the same as the height of the cylinder.

4. The length of the rectangle is the circumference of the cylinder. You could determine the length of the rectangle by using the formula $C = \pi d$ and plugging in the values.

5. Answers will vary depending on the dimensions of the paper tube. Students should use the formula $A = l \times w$.

6. a) Answers will vary. Students should use the formula $A = \pi r^2$ to find the area of one face.

b) Answers will vary. Students should find that $SA = 2$ (SA of a face) + (SA of the rectangle).

7. Answers will vary. Sample answer: You can calculate the surface area of the two circular faces on a cylinder (circle) and add the surface area of the curved side (rectangle).

Examples

- As a class, work through each of the Examples to be sure that students understand the concepts about surface area and volume of cylinders.
- In Example 1, read the MathConnect about π. Have students compare 3.14 with the value a calculator provides. Ask students to think of an example when using a more accurate value for π is advantageous. For example, scientists must know the accurate value of pi to fit together two circular parts on the International Space Station.
- Relate the MathConnect that indicates that 1 cm^3 = 1 mL to the volume units students often see on canned goods.
- In Example 2, review the formulas for area and volume of a cylinder.
- In Example 4, draw students' attention to the MathConnect about silos. Ask students what units indicate capacity of storage in silos (m^3).

Key Concepts

- Ensure that students understand the Key Concepts before assigning the Practise the Concepts questions.
- Have students add the formulas for surface area and volume of a cylinder to their Discussion Chart.

Discuss the Concepts

- Have students complete and then discuss the questions in a class discussion.
- For D1, divide the class into two groups. Have one group convert cubic inches to cubic feet and the other group convert cubic feet to cubic inches. You may need to review why three conversions are needed (volume has three length measurements, each of which needs to be converted).
- For D2, listen to students' oral explanations to assess their understanding of using values for pi.
- For D3, before students generalize the effect of doubling the height of a cylinder on the volume of the cylinder, have them do the calculations for each scenario. Have students divide the larger volume by the smaller volume to find the factor. You can then have them use the quick method to find the factor change in the volume.

Discuss the Concepts Suggested Answers (page 385)

D1. a) It is possible that both answers are correct since the units are different.

b) Both girls are correct. Each girl is using different units of measure. $78.5 \times 12 \times 12 \times 12 = 135\ 648$. Multiplying by 12 three times changes each foot measurement to inches.

D2. a) Look for an example where an approximate value for π is appropriate. For example: padding around a cylinder.

b) Look for an example that indicates the need for two pieces to fit together exactly. For example: nozzle head on a pesticide sprayer unit, when it is important to avoid pesticide spills.

D3. Doubling the height doubles the volume of a cylinder.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.

Apply the Concepts (B)

- Question 9 can be used as a Literacy Connect. Literacy Connect questions offer the opportunity to explore literacy issues in the mathematics classroom and within the context of mathematics. This supports general Think Literacy strategies. For more information, visit http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy.
- Question 11 is a Chapter Problem. Allow students to construct the container using cardstock paper and tape. In advance, consider asking students to bring in skateboard wheels to see what size of container is needed. Remind students to keep the solution handy to help with the Chapter Problem Wrap-Up.

Extend the Concepts (C)

- Assign the Extend the Concepts questions to students who are not being challenged by questions in Apply the Concepts.
- Extend the Concepts questions can be used as a diagnostic assessment for those students considering a university-level course in grade 11.