1.2 Volume

Student Text Pages
18–25

Suggested Timing
80–160 min

Tools
- scientific calculators

Optional
- Polydron® pieces, geometric solids, or linking cubes

Related Resources
BLM 1-6 Section 1.2 Work with Volume
BLM 1-7 Section 1.2 Frayer Model
BLM 1-8 Section 1.2 Volume
BLM 1-9 Section 1.2 Achievement Check Rubric

Link to Prerequisite Skills

Students should complete Algebra, Converting Measures, Perimeter, Circumference, and Area, and Three-Dimensional Figures in the Prerequisite Skills before proceeding with this section.

Warm-Up

1. What is volume? What units are used to measure volume?
2. What is the formula for the volume of each figure?
a) a rectangular-based prism
b) a cylinder

Warm-Up Answers

1. Volume is the amount of space an object occupies. It is measured in cubic units, such as cubic centimetres and cubic metres.
2. Volume = base area × height
a) $V = lwh$ **b)** $V = \pi r^2 h$

Teaching Suggestions

- You may wish to complete this section over two periods. Monitor students' progress as they work through Examples 1 and 2, Discuss the Concepts, and the Practise questions. If necessary, work through Example 3 and the Apply and Extend questions the next day.
- There should be little emphasis on memorizing formulas but great emphasis on application of concepts.

Warm-Up

- Display the Warm-Up questions. Have students complete the questions independently. Then, discuss the solutions as a class.

Section Opener

- Have students look at the photographs and consider the shapes they see. Ask students to identify these shapes in landmark buildings within or near their town or city.

Examples

- Example 1 introduces a triangular prism. Manipulatives such as Polydron® pieces or geometric solids may help students recognize that the base of a prism can appear in a number of different orientations, as mentioned in the Literacy Connect box in the margin. If the base appears on the bottom or top of the figure, it makes sense to relate the base area to the height of the prism. If the base is in the front/back or left/right side orientation, it may be more meaningful to relate the base area to the length of the prism. Explain that these terms are relative and that students should understand the relationship between these measures.
- Students should know how to calculate the volumes of prisms and cylinders. Example 2 poses a more challenging question. Students should apply skills related to rearranging equations and formulas. Method 1

uses a systematic application of reversing operations to solve for a variable after substituting known information into a formula. Method 2 applies the algebraic manipulation prior to substituting. Although slightly more abstract, an advantage of Method 2 is that a new representation of the formula is developed which can be re-used in similar situations. Most students would benefit from exposure to both of these solution approaches.

- Example 3 introduces the volume of a composite figure. A manipulative model may help some students to visualize the figure and to see how it can be broken into components, as in Method 1. The model will also help students to visualize how to use net volume and proportional reasoning, as in Method 2. Consider using colour coding to distinguish the subtracted component from the rest of the model.
- Supply students with **BLM 1-6 Section 1.2 Work With Volume** for more practice with finding the volume of composite figures.

Key Concepts

- Review the Key Concepts. Suggest that students write the concepts in their notebooks and highlight the volume formulas.

Discuss the Concepts

- Assign these questions to pairs of students. After discussing their answers with a partner, students can write individual solutions in their notebooks.
- You could have students complete a Frayer model for **questions D1 and D2**. Supply students with **BLM 1-7 Section 1.2 Frayer Model**.

Discuss the Concepts Suggested Answers (page 22)

D1. a) A prism has two congruent, parallel polygon faces connected by rectangular faces.

b) Answers may vary.

D2. a) Yes. It has two congruent, parallel faces, which are both circles. The circular faces are connected by one curved rectangular face.

b) The base area of a cylinder is the area of a circle, which is $A = \pi r^2$. So the volume is $V =$ Base area $\times$ Height or $V = \pi r^2 h$.

D3. Convert the height of the cylinder to metres. Calculate the area of the circular base of the cylinder. Multiply the base area by the height to find the volume.

Practise (A)

- You may wish to have students work in pairs or small groups to complete the Practise questions.
- Encourage students to refer to the Examples before asking for assistance.
- Several of the problems in this section can be modelled using manipulatives, such as Polydron® pieces, linking cubes, or geometric solids. Students could also use TABS+ software to design and build a number of these models. Make as many of these resources available to students as possible.
- For **question 4**, some students may need to review ratios and proportions to understand how to convert cubic centimetres to litres.

Apply (B)

- For **questions 6 to 8**, supply students with real-world objects such as hockey pucks, soup cans, and snack bar wrappers to help them visualize the problems and enhance the relevance of the mathematical content.
- **Question 9** is an Achievement Check question. It can be used as a diagnostic or formative assessment, or assigned as a small summative assessment piece. You may wish to use **BLM 1-9 Section 1.2 Achievement**

Common Errors

- Some students may choose the incorrect formula or substitute values into a formula without properly understanding whether it is appropriate to do so.

R_x Have students work with concrete materials such as layers of linking cubes for rectangular-based prisms or hockey pucks for cylinders to consolidate an understanding of the volume formulas. Extend these results to other prisms. Students can then focus on determining the base area and identifying the height or length.

Accommodations

Spatial—use linking cubes or three-dimensional geometric models to represent composite shapes

Language—provide labelled models of common shapes, such as rectangular prisms, triangular prisms, and cylinders

Memory—post the volume formulas for prisms and cylinders

ESL—provide students with three-dimensional models for the Examples and Practise questions

Check Rubric to assist you in assessing your students. Some students may need help applying the given information to an appropriate measurement model. Suggest that students draw a single log from a different perspective and label it with the given information.
- For **question 10**, it may be helpful to have several real-world objects available, such as paint cans, soup cans, boxes, and lampshades.

Extend (C)

- Assign the Extend questions to students who are not being challenged by the Apply questions.
- For **question 12**, ask students why this shape would be preferable for aircraft. A photograph or a model of an airplane with tapered wings might be helpful.
- Ask students to share how they solved **question 13**.

Achievement Check Answers (page 24)

9. a) Determine the radius of an average log. Since the circumference is 2 m:

$2\pi r = 2$

$r = \frac{2}{2\pi}$

$= 0.318$

The radius of each log is approximately 0.318 m.

The logs are in the shape of cylinders.

Volume of one log $= \pi r^2 h$

$= \pi(0.318)^2(15)$

$= 4.765$

Total volume of wood $= 21 \times 4.765$

$= 100.065$

Abdi can haul approximately 100 m^3 of wood in one load.

b) Answers may vary. For example, assume the logs are identical in shape and volume, and that each log is a cylinder (same diameter for the entire length).

Mathematical Process Expectations

Process Expectation	Questions
Problem Solving	6, 7, 9, 13
Reasoning and Proving	2–4, 9, 12
Reflecting	9
Selecting Tools and Computational Strategies	5, 6
Connecting	6, 7, 9–13
Representing	3, 4, 10, 11
Communicating	2–4, 9, 12

Ongoing Assessment

- While students work, circulate and see how well each student works. This may be an opportunity to observe and record individual students' learning skills.

Extra Practice

- Use **BLM 1-8 Section 1.2 Volume** for remediation or extra practice.