CBC Grade 10 Mathematics Lesson Plan

Volume of Prisms

Strand	Measurement and Geometry
Sub-Strand	Volume
Specific Learning Outcome	Calculate the volume of prisms using the formula Volume = Area of base × Height
Key Inquiry Questions	How do we calculate the volume of prisms with different base shapes?
Learning Resources	CBC Grade 10 textbooks, unit cubes, grid paper, ruler, calculator
Lesson Duration	40 minutes

Lesson Structure Overview

Phase	Activity	Duration
Phase 1	Problem-Solving and Discovery (Anchor Activity)	15 minutes
Phase 2	Structured Instruction (Key Takeaways)	10 minutes
Phase 3	Practice and Application (Worked Examples)	15 minutes
Phase 4	Assessment (Exit Ticket)	5 minutes

Phase 1: Problem-Solving and Discovery (15 minutes)

Anchor Activity: Building Prisms with Unit Cubes

Work in Groups (2-3 students)

Materials:

- • Grid/graph paper
- • Ruler
- • Paper-made unit cubes (or square cut-outs)
- • Calculator

Context:

A prism is a solid with two identical parallel faces called bases, and flat faces connecting corresponding edges of the bases. The volume of a prism depends on the area of its base and how "deep" that base extends in space.

Tasks:

1. (a) Consider a rectangular base with dimensions 3 units by 2 units. Count the number of unit squares in the base.
2. (b) Verify your answer using multiplication.
3. (c) Now imagine stacking identical layers to form a prism of height 5 units. How many layers are stacked?
4. (d) How many unit cubes are in the entire prism?
5. (e) Verify your answer using multiplication.
6. (f) What relationship do you observe between: Area of the base, Height of the prism, and Total number of unit cubes in the prism?

Teacher Guidance for Anchor Activity

This anchor activity helps students discover the fundamental relationship: Volume = Area of base × Height. By physically counting unit cubes and then verifying with multiplication, students connect the abstract formula to concrete visualization.

Facilitation Strategy:

- • Organize students into groups of 2-3
- • Distribute grid paper, rulers, and unit cubes
- • Guide students to draw the 3×2 rectangular base first
- • Ask: "How many squares cover the base?" (Expected: 6)
- • Guide students to imagine stacking 5 identical layers
- • Ask: "How many cubes total?" (Expected: 30)
- • Probe: "What pattern connects base area, height, and total cubes?"
- • Students should discover: Total cubes = Base area × Height

Phase 2: Structured Instruction (10 minutes)

Key Takeaways

After students have explored through the anchor activity, formalize their discoveries with these key concepts:

1. Definition of Volume

Volume of a three-dimensional shape is the amount of space it occupies, measured in cubic units (cm^3, m^3). The number of unit cubes that fit inside a prism depends on the area of the base and the height (depth) of the prism.

2. Universal Prism Volume Formula

For ANY prism:

Volume = Area of base × Height

This formula works regardless of the shape of the base (rectangle, triangle, pentagon, or any polygon), as long as the cross-section is constant along the height.

3. Volume of Specific Prisms

Prism Type	Base Area Formula	Volume Formula
Rectangular Prism (Cuboid)	A = length × width	V = l × w × h
Cube	A = $side^2$	V = $side^3$
Triangular Prism	A = ½ × base × height	V = (½bh) × H

4. Key Principle

The volume of a prism depends on:

- • The area of its base (how much surface the base covers)
- • How "deep" that base extends in space (the height)
- • Larger base area OR greater height → larger volume

5. Units Matter

- • Linear measurements: cm, m (one dimension)
- • Area measurements: cm^2, m^2 (two dimensions)
- • Volume measurements: cm^3, m^3 (three dimensions)
- • Always ensure all dimensions use the same unit before calculating

Scaffolding Strategies

Address common challenges revealed during the anchor activity:

- • Emphasize that volume is "how many cubes fit inside"
- • Connect multiplication to repeated addition of layers
- • Use visual diagrams showing base area and height clearly
- • Stress that the formula works for ANY base shape
- • Provide reference chart with base area formulas

Phase 3: Practice and Application (15 minutes)

Worked Examples

Example 1: Rectangular Prism

Find the volume of a rectangular prism with base 6 × 4 units and height 8 units.

Solution:

Step 1: Find base area: A = 6 × 4 = 24 $units^2$

Step 2: Apply formula: V = Base area × Height

Step 3: V = 24 × 8 = 192 $units^3$

Answer: 192 cubic units

Example 2: Triangular Prism

Find the volume of a triangular prism whose base is a triangle with area 12 cm^2 and height 10 cm.

Solution:

Step 1: Base area is given: A = 12 cm^2

Step 2: Apply formula: V = Base area × Height

Step 3: V = 12 × 10 = 120 cm^3

Answer: 120 cm^3

Example 3: Pentagonal Prism

A pentagonal prism has a base area of 20 m^2 and a height of 7 m. Find its volume.

Solution:

Step 1: Base area is given: A = 20 m^2

Step 2: Apply formula: V = Base area × Height

Step 3: V = 20 × 7 = 140 m^3

Answer: 140 m^3

Example 4: Cube

Find the volume of a cube whose side is 5 cm.

Solution:

Step 1: For a cube, base area = $side^2$ = 5^2 = 25 cm^2

Step 2: Height = side = 5 cm

Step 3: $V = 25 \times 5 = 125$ cm^3

Alternative: $V = \text{side}^3 = 5^3 = 125$ cm^3

Answer: 125 cm^3

Individual Practice (Students work independently)

Provide students with similar problems to solve:

7. 1. A rectangular prism has base 5 × 3 units and height 10 units. Find volume.
8. 2. A triangular prism has base triangle area 15 cm^2 and height 9 cm. Find volume.
9. 3. A cube has side length 12 cm. Find its volume.

Phase 4: Assessment - Exit Ticket (5 minutes)

Students complete individually to demonstrate understanding:

Question 1: A rectangular prism has base 8 × 2.5 metres and height 6 metres. Find its volume in m^3.

Question 2: A prism has a volume of 200 cm^3 and a height of 10 cm. What is the area of its base?

Question 3: Explain in your own words: Why does the formula Volume = Area of base × Height work for ANY prism, regardless of base shape?

Exit Ticket Answer Key

Question 1:

Base area = $8 \times 2.5 = 20$ m^2

$V = 20 \times 6 = 120$ m^3

Question 2:

V = Base area × Height

200 = Base area × 10

Base area = $200 \div 10 = 20$ cm^2

Question 3:

The formula works because volume measures how many unit cubes fit inside. The base area tells us how many cubes fit in one layer, and the height tells us how many layers we stack. Multiplying these gives the total number of cubes, which is the volume. The shape of the base doesn't matter—only its area.

Differentiation Strategies

For Struggling Learners:

- • Provide physical unit cubes to manipulate
- • Use grid paper to draw and count squares
- • Break formula into two steps: 1) Find base area, 2) Multiply by height
- • Focus on rectangular prisms and cubes initially
- • Provide formula reference card

For Advanced Learners:

- • Introduce prisms with complex polygon bases (hexagon, octagon)
- • Challenge with working backwards (given volume, find dimensions)
- • Explore how changing dimensions affects volume (doubling, tripling)
- • Connect to real-world applications (storage, construction)
- • Introduce composite solids made of multiple prisms

Extension Activity

Build a Bridge with Triangular Prisms

Objective: Apply volume calculations to engineering design.

Activity Description:

10. 1. Work in groups of 5 students.
11. 2. Materials: Cardboard or wooden sticks, ruler, calculator.
12. 3. Construct a bridge model with triangular prism supports.
13. 4. Measure the base, height of the triangle, and length of the prism.
14. 5. Calculate the volume of the prism-shaped supports using $V = (\frac{1}{2}bh) \times H$.
15. 6. Compare different bridge designs and discuss which structure is strongest.

Why triangular prisms in bridges?

- • Distribute weight evenly
- • Provide structural stability
- • Used in real-life construction (trusses)

Post-Lesson Reflection for Teachers

- • Did students successfully discover the Volume = Base area × Height relationship?
- • Were students able to apply the formula to different base shapes?
- • What misconceptions emerged about volume or units?
- • How engaged were students with the unit cube activity?
- • Did students understand that the formula works for ANY prism?
- • What adjustments are needed for future lessons on this topic?