CBC Grade 10 Mathematics Lesson Plan

Surface Area of Prisms

Lesson Information

Strand	**Measurement and Geometry**
Sub-Strand	Surface Area
Specific Learning Outcome	Determine the surface area of prisms, pyramids, cones, frustums and spheres
Key Inquiry Questions	How do we determine the surface area and volume of solids? Why do we determine the surface area and volume of solids?
Duration	40 minutes

Learning Resources

- CBC Grade 10 textbooks
- Solid objects (cube or cuboid wood waste blocks)
- Grid/graph paper or plain paper
- Rulers
- Pre-made nets of cubes or cuboids (optional)
- Calculators

Lesson Structure (40 Minutes)

Phase	Duration
Phase 1: Problem-Solving and Discovery	0-15 minutes
Phase 2: Structured Instruction	15-25 minutes
Phase 3: Practice and Application	25-37 minutes
Phase 4: Assessment (Exit Ticket)	37-40 minutes

Phase 1: Problem-Solving and Discovery (0-15 Minutes)

Anchor Activity: Discovering Surface Area Through Nets

Work in groups: Form groups of 2 or 3 students.

Materials Needed:

- • Solid cube or cuboid wood waste blocks
- • Grid/graph paper or plain paper
- • Rulers
- • Pre-made nets of cubes or cuboids (optional)

Instructions:

1. 1. Choose one solid object (cube or cuboid).

2. 2. Create a net for the chosen object (either by unfolding a model or using drawn net templates).
3. 3. Trace the faces onto grid paper or measure them using a ruler.
4. 4. Calculate the area of each face.
5. 5. Add up all face areas to find the total surface area.

Discussion Questions:

- • What will happen if the surface area doubles in size?
- • Why do bigger cubes have more surface area?

Teacher's Role:

Circulate among groups, observing how students approach the task. Ask probing questions such as: "How many faces does your object have?" "Are all the faces the same size?" "How can you check if you've counted all the faces?" Listen for student discoveries about the relationship between dimensions and surface area. Use their solutions to bridge to formal instruction in Phase 2.

Phase 2: Structured Instruction (15-25 Minutes)

After students have explored surface area through nets, formalize the concepts they discovered.

Key Takeaways:

Definition of Surface Area:

The surface area of a cube or cuboid is the total area of all its faces. It can be calculated by finding the area of each face and then adding them together.

Cube:

• A cube has 6 identical square faces.

• Surface Area of a Cube = $6s^2$ where s = side length of the cube.

Cuboid (Rectangular Prism):

• A cuboid has 6 rectangular faces.

• Surface Area of a Cuboid = 2(lw + lh + wh) where l = length, w = width, h = height.

Prisms:

• A prism is a geometric object with two identical, parallel bases and straight sides connecting them.

• A cuboid is also called a rectangular prism. A cube is a rectangular prism with all sides of equal length.

• Examples of right prisms are cylinders, rectangular prisms, cubes and triangular prisms.

• Types of prisms include rectangular and cube prisms, triangular prisms and cylinders.

General Formula for Prisms:

Surface Area = 2 × Area of Base + Perimeter of Base × Height

Surface Area = 2F + Pl

where F is the area of the base, P is the perimeter of the base, and l is the length (or height) of the prism.

Scaffolding Strategies:

• Address misconceptions revealed during the Anchor Task, such as confusing perimeter with area or forgetting to count all faces.

• Use visual diagrams to show how nets unfold into 3D shapes.

• Emphasize that surface area is measured in square units (cm^2, m^2).

• Connect student discoveries to formal formulas.

Phase 3: Practice and Application (25-37 Minutes)

Provide varied problems that require reasoning, problem-solving, and application of learned procedures.

Worked Examples:

Example 1: Cube with Side 12 cm

Problem: Work out the surface area of a cube whose side is 12 cm.

Solution:

The area of one face of the cube is: $s^2 = 12^2 = 144\ cm^2$

Surface Area = $6s^2 = 6(12^2) = 6(144) = 864\ cm^2$

Example 2: Cube with Side 8 cm

Problem: Work out the surface area of the cube whose side is 8 cm.

Solution:

Surface Area = $6s^2 = 6(8^2) = 6(64) = 384\ cm^2$

Example 3: Triangular Prism

Problem: Find the surface area of a triangular prism with base 8 cm, triangle height 3 cm, and length 12 cm.

Solution:

Step 1: Area of one triangular face = ½ × 8 × 3 = 12 cm^2

Step 2: Two faces = 2 × 12 = 24 cm^2

Step 3: Perimeter = 8 + 5 + 5 = 18 cm (using Pythagorean theorem for slant sides)

Step 4: Lateral area = 18 × 12 = 216 cm^2

Step 5: Total Surface Area = 24 + 216 = 240 cm^2

Individual Practice:

Allow students 7 minutes to work on these problems individually or in pairs:

6. 1. A cube has side length 9 cm. Find its total surface area.
7. 2. A rectangular box measures 12 cm by 7 cm by 5 cm. Calculate its total surface area.
8. 3. A pet shop wants to construct a cube-shaped aquarium with a side length of 1.2 meters. The aquarium needs to be made entirely of glass, including the base and all four vertical sides, but the top will remain open. If the cost of glass is Ksh. 750 per square meter, find the total cost of constructing the aquarium.

Phase 4: Assessment - Exit Ticket (37-40 Minutes)

Exit Ticket Questions:

9. 1. A cube has side length 9 cm. Find its total surface area.
10. 2. A rectangular box measures 12 cm by 7 cm by 5 cm. Calculate its total surface area.
11. 3. A pet shop wants to construct a cube-shaped aquarium with a side length of 1.2 meters. The aquarium needs to be made entirely of glass, including the base and all four vertical sides, but the top will remain open. If the cost of glass is Ksh. 750 per square meter, find the total cost of constructing the aquarium.
12. 4. A cuboid-shaped water tank measures 4 m by 3 m by 2 m. Only the four walls and the base are painted. Find the area painted.

Assessment Criteria:

- • Correct identification of shape type (cube vs. cuboid)
- • Proper formula selection
- • Accurate calculation of face areas
- • Correct addition of all face areas
- • Appropriate use of square units

Differentiation Strategies

For Struggling Learners:

- • Provide pre-drawn nets with labeled dimensions
- • Use color coding for different faces
- • Allow calculators for all calculations
- • Provide formula reference cards
- • Pair with peer tutors

For Advanced Learners:

- • Extension activity: Design a box with specific surface area constraints
- • Challenge: Find dimensions of a cuboid given its surface area and one dimension
- • Real-world investigation: Calculate surface area of classroom objects
- • Explore relationship between surface area and volume

Extension Activity

Design Challenge:

A company wants to design a rectangular gift box with a volume of 1000 cm^3. Design three different boxes (with different dimensions) that all have this volume. Calculate the surface area of each design. Which design uses the least material (smallest surface area)? Explain why minimizing surface area is important for packaging companies.

This activity encourages students to:

- • Apply surface area formulas in a real-world context
- • Explore the relationship between dimensions, volume, and surface area
- • Develop reasoning about optimization
- • Connect mathematics to business and environmental considerations

Formative Assessment Strategies

Throughout the Lesson:

- • Observation: Circulate during group work to observe student strategies and misconceptions
- • Questioning: Ask probing questions such as "How do you know you've counted all the faces?" "What pattern do you notice?"
- • Student Sharing: Have groups present their solutions and explain their reasoning
- • Exit Ticket: Use the final assessment to check individual understanding

Teacher Notes

Key Points to Emphasize:

- • Surface area is the total area of all faces
- • Each face must be counted exactly once
- • Surface area is measured in square units
- • The formula for cubes is simpler because all faces are identical
- • Nets help visualize all the faces of a 3D object

Common Student Errors:

- • Confusing surface area with volume
- • Forgetting to count all faces
- • Using linear units instead of square units
- • Confusing perimeter with area
- • Miscalculating face areas