# Grade 10 Mathematics Lesson Plan

## Surface Area of Pyramids

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| **Strand:** | **Measurement and Geometry** |
| **Sub-Strand:** | Surface Area of a Pyramid |
| **Specific Learning Outcome:** | Determine the surface area of prisms, pyramids, cones, frustums and spheres. |
| **Duration:** | 40 minutes |
| **Key Inquiry Question:** | How do we determine the surface area and volume of solids? Why do we determine the surface area and volume of solids? |
| **Learning Resources:** | CBC Grade 10 textbooks, colored paper or cardstocks, scissors, rulers, glue or tape, markers |

### Lesson Structure Overview

| Phase | Duration | Focus |
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| **Problem-Solving and Discovery** | 15 minutes | Anchor activity: Constructing pyramid nets and discovering surface area |
| **Structured Instruction** | 10 minutes | Formalizing the pyramid surface area formula and addressing misconceptions |
| **Practice and Application** | 10 minutes | Worked examples and varied problems |
| **Assessment** | 5 minutes | Exit ticket to check understanding |

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

**Anchor Activity: Net of a Triangle Based Pyramid - Paper Folding**

Objective: Students will discover the formula for finding the surface area of a pyramid by constructing a pyramid net from paper and exploring the relationship between the base and triangular faces.

**Materials Needed:**

- Colored paper or cardstocks

- Scissors
- Rulers
- Glue or tape
- Markers

**Steps for the Activity:**

1. Step 1: Observe the Net. Observe the net of the pyramid shown in the textbook.
2. Step 2: Draw the Net. Draw on the colored paper or cardstocks the net of a pyramid (four triangles). Note the sides of the triangles and height should be equal.
3. Step 3: Cut the Net. Cut off the extra paper to remain with the pyramid net.
4. Step 4: Fold to Form Pyramid. Fold along the edges to form a pyramid. Hold the triangles in position using tape.
5. Step 5: Measure Dimensions. Using a ruler, measure the base height and slant height of the triangular faces.
6. Step 6: Find the Surface Area. Calculate the surface area of the pyramid you have constructed.

**Discussion Questions:**

7. What is a pyramid?
8. What shapes make up the net of a pyramid?
9. How many faces does your pyramid have?
10. How did you calculate the surface area of the pyramid?
11. What is the difference between the base and the lateral faces?

**Teacher Role During Discovery:**

- Circulate among groups, ensuring students understand how to draw and cut the pyramid net accurately.
- Ask probing questions: What shapes do you see in the net? How can we find the area of each shape?
- For struggling groups: Let us find the area of the base first. Then find the area of each triangular face. What do we do next?
- For early finishers: Can you write a general formula for finding the surface area of any pyramid?
- Guide students to articulate: The surface area of a pyramid equals the base area plus the sum of all triangular face areas.
- Identify 2-3 groups with clear findings to share with the class.

## Phase 2: Structured Instruction (10 minutes)

**Formalizing the Pyramid Surface Area Formula and Addressing Misconceptions**

After students have completed the anchor activity and shared their findings, the teacher formalizes the formula for finding the surface area of a pyramid.

**Key Takeaway: What is a Pyramid?**

A pyramid is a geometric solid object that has a polygon as its base and faces that converge at a point called the apex. In other words, the faces are not perpendicular to the base.

**Types of Pyramids:**

- Triangle base: Called triangular pyramid
- Square base: Called square pyramid
- The pyramids take their names after the shape of their base

**Right Pyramid:**

A right pyramid has a line between the apex and the centre of the base that is perpendicular to the base.

**Formula:**

Surface Area of a Pyramid = Base Area + Sum of all triangular face areas

For a square pyramid:

Surface Area = Base Area + 4 times (Area of one triangular face)

Where:

- Base Area = side times side (for square base)
- Area of triangular face = (1 / 2) times base times slant height

**Scaffolding Strategies to Address Misconceptions:**

- Misconception: A pyramid is the same as a prism. Clarification: No, a pyramid has triangular faces that meet at an apex, while a prism has rectangular faces and two parallel bases.
- Misconception: I only need to find the area of the triangular faces. Clarification: No, you must add the base area to the sum of all triangular face areas.
- Misconception: All pyramids have square bases. Clarification: No, pyramids can have triangular, square, rectangular, or any polygonal base.
- Misconception: The height and slant height are the same. Clarification: No, the slant height is the distance along the triangular face from the apex to the base edge, while the height is the perpendicular distance from the apex to the base.

## Phase 3: Practice and Application (10 minutes)

**Worked Example:**

Find the surface area of a square pyramid with a height of 6 cm and a side length of 4 cm.

Given: b = 2 by 2 and H = 4

Solution:

Surface Area = Base area + 4 times (area of triangles)

Step 1: Find the base area.

Base Area = 2 cm times 2 cm = 4 cm squared

Step 2: Find the area of one triangular face.

Area of one triangle = (1 / 2) times base times height

= (1 / 2) times 2 cm times 4 cm

= 4 cm squared

Step 3: Find the area of all triangular faces.

Area of all triangles = 4 cm squared times 4 triangles

= 16 cm squared

Step 4: Find the total surface area.

Surface area = 16 cm squared + 4 cm squared

= 20 cm squared

The surface area for the square pyramid is 20 cm squared.

## Phase 4: Assessment (5 minutes)

**Exit Ticket:**

Students complete the following questions individually.

1. A pyramid with a square base has a total surface area of 400 cm squared, and its base side measures 8 cm. Using the formula for surface area, calculate the slant height of the pyramid.

2. A square pyramid has a base with sides of 24 cm each, and the height of the triangular face is 18 cm. Find the total surface area of the pyramid.

3. A miniature paper pyramid is being designed with a square base of 12 cm by 12 cm and a slant height of 20 cm. How much paper is required to construct the entire pyramid?

**Answer Key:**

1. Base area = 8 times 8 = 64 cm squared. Let slant height = h. Surface area = 64 + 4 times (1 / 2 times 8 times h) = 64 + 16h. Given 400 = 64 + 16h, therefore 16h = 336, h = 21 cm.

2. Base area = 24 times 24 = 576 cm squared. Area of triangular faces = 4 times (1 / 2 times 24 times 18) = 4 times 216 = 864 cm squared. Total surface area = 576 + 864 = 1440 cm squared.

3. Base area = 12 times 12 = 144 cm squared. Area of triangular faces = 4 times (1 / 2 times 12 times 20) = 4 times 120 = 480 cm squared. Total paper required = 144 + 480 = 624 cm squared.

## Differentiation Strategies

**For Struggling Learners:**

- Provide pre-drawn pyramid nets for students to cut and fold.
- Use square pyramids with simple dimensions for initial practice.
- Pair struggling students with confident problem solvers.
- Provide step-by-step calculation templates.
- Allow use of calculators for calculations.
- Break down the formula into steps: Find base area, find area of one triangular face, multiply by number of faces, add.

**For On-Level Learners:**

- Encourage students to verify their formula with different pyramid types.
- Ask students to explain the difference between a pyramid and a prism.
- Provide mixed practice with square and rectangular pyramids.
- Challenge students to find the surface area of pyramids with different base shapes.

**For Advanced Learners:**

- Challenge students to derive the formula for triangular pyramids using Heron's formula.
- Explore real-world applications: Egyptian pyramids, tent roofs, food containers, architectural designs.
- Investigate problems where the slant height must be calculated using Pythagorean theorem.
- Apply the concept to composite solids involving pyramids.
- Solve optimization problems: Given a fixed surface area, what dimensions maximize the volume?

## Extension Activity

**Real-World Application: Observing Pyramidal Objects in the Environment**

Work in groups

Situation: Identify pyramid-shaped objects around school or home (e.g., tent, roof, food container, toys, etc.).

Tasks:

12. Identify at least three pyramid-shaped objects in your environment.
13. Measure the dimensions of each object or use estimated values.
14. Calculate the surface area of each object using the pyramid formula.
15. Compare your results with classmates and discuss any differences.
16. Present your findings with diagrams, measurements, and calculations.

**Key Takeaway:**

Students should understand how the surface area of pyramids is used in real-world contexts such as architecture (Egyptian pyramids, building roofs), packaging (food containers), camping equipment (tents), and toy design.

## Teacher Reflection Prompts

- Did students successfully discover the pyramid surface area formula through the anchor activity?
- Were students able to construct pyramid nets and fold them accurately?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did students understand the difference between a pyramid and a prism?
- What adjustments would improve this lesson for future classes?