Grade 10 Mathematics Lesson Plan

Area of Parallelograms

Strand:	**Measurement and Geometry**
Sub-Strand:	Area of Polygons: Area of Quadrilaterals
Specific Learning Outcome:	Determine the area of quadrilaterals in different situations. Explore the area of polygons as used in real-life situations.
Duration:	40 minutes
Key Inquiry Question:	How do we work out the area of polygons?
Learning Resources:	CBC Grade 10 textbooks, graph paper, scissors, rulers, colored pencils, parallelogram templates

Lesson Structure Overview

Phase	Duration	Focus
Problem-Solving and Discovery	15 minutes	Anchor activity: Exploring the area of a parallelogram using graph paper
Structured Instruction	10 minutes	Formalizing the formula: Area = base x height
Practice and Application	10 minutes	Worked examples using the formula
Assessment	5 minutes	Exit ticket to check understanding

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

Anchor Activity: Exploring the Area of a Parallelogram

Students work in groups to draw a parallelogram on graph paper, drop a perpendicular to find the height, and discover the relationship between the area of a parallelogram and the area of a rectangle.

Materials Needed:

- Graph paper
- Scissors
- Ruler

- Colored pencils
- A printed or drawn parallelogram template
- Pair of compasses

Steps for the Activity:

1. Draw a parallelogram: On graph paper, draw a parallelogram with a given base and height. Label the vertices A, B, C and D.
2. Use a pair of compasses to drop a perpendicular. Label the intersection point on line CD as H representing the height of the parallelogram.
3. Use a ruler to measure and compare opposite sides (AB and CD, BC and AD).
4. Cut out the parallelogram and rearrange it to form a rectangle.
5. Calculate the area of the rectangle and compare it to the area of the parallelogram.
6. Discuss your findings with your group members.

Recording Table for Student Observations:

Base (cm)	Height (cm)	Area of Parallelogram (cm^2)	Area of Rectangle (cm^2)
___	___	___	___

Teacher Role During Discovery:

- Circulate among groups, ensuring students understand how to drop a perpendicular correctly.
- Ask probing questions: "What shape do you get when you rearrange the parallelogram?" "How does the area of the parallelogram compare to the area of the rectangle?"
- For struggling groups: "Let us draw the perpendicular together. It must be at a right angle to the base."
- For early finishers: "Can you find a formula for the area of a parallelogram?"
- Guide students to articulate: "The area of a parallelogram is base x height, just like a rectangle."
- Identify 2-3 groups with clear calculations to share with the class.

Discovery Table: Linking Observations to Mathematical Significance

Student Observation	Mathematical Significance
The parallelogram can be rearranged to form a rectangle	The area of a parallelogram equals the area of a rectangle with the same base and height

Opposite sides of the parallelogram are equal and parallel	This is the defining property of a parallelogram
The height is the perpendicular distance between parallel sides	The height must be measured at a right angle to the base
The area formula is base x height	Area = b x h, where b is the base and h is the perpendicular height
The slant side does not affect the area	Only the base and perpendicular height determine the area

Phase 2: Structured Instruction (10 minutes)

Formalizing the Formula: Area = base x height

After students have completed the anchor activity and shared their findings, the teacher formalizes the area formula for parallelograms.

Key Takeaway:

A parallelogram is a quadrilateral whose opposite sides are equal and parallel. Which other quadrilateral has similar characteristics like these?

Formula:

The area of a parallelogram is given by: Base x Height

A = b x h

where b is the base and h the perpendicular distance between the given pair of parallel sides.

Example Calculation:

The area of a parallelogram given the base is 28 cm and the height 8 cm is:

A = b x h

A = 28 cm x 8 cm

$A = 224\ cm^2$

Scaffolding Strategies to Address Misconceptions:

- Misconception: "I can use the slant side as the height." Clarification: "No, the height must be the perpendicular distance between parallel sides."
- Misconception: "The area formula is different from a rectangle." Clarification: "No, the formula is the same: base x height."
- Misconception: "I need to know all four sides to find the area." Clarification: "No, you only need the base and the perpendicular height."
- Misconception: "The height is always vertical." Clarification: "No, the height is perpendicular to the base, which can be horizontal or at an angle."

Phase 3: Practice and Application (10 minutes)

Worked Example:

Example 1: Using Sine to Find Height (Textbook Example 2.5.6)

A parallelogram PQRS is of sides 28 cm and 7 cm. If angle QRS is 75°.

a. Find the height of the parallelogram using sine rule.

b. Find the area of the parallelogram.

Solution:

a. From Q drop a perpendicular to meet RS at T considering angle QRS.

Height (QT) = Hypotenuse(QR) x sin(angle)

QT = 7 sin 75°

QT = 6.76 cm

b. Area of PQRS = RS x QT

= 28 x 7 sin 75°

$= 189.32 \text{ cm}^2$

The area of the parallelogram is 189.32 cm^2.

Phase 4: Assessment (5 minutes)

Exit Ticket:

Students complete the following questions individually.

1. Find the missing height of the parallelogram ABCD given the area is 24 cm^2 and base is 6 cm.

2. A construction company is building a parallelogram-shaped floor with a base of 10 meters and height of 6 meters. Find the area of the floor.

3. A billboard has a parallelogram shape with a base of 12 feet and a height of 5 feet. Find the area of the billboard.

4. A solar panel is shaped like a parallelogram with a base of 8 meters and an inclined height of 4 meters. Find its surface area.

Answer Key:

1. Height = Area / base = 24 / 6 = 4 cm

2. Area = base x height = 10 x 6 = 60 m^2

3. Area = base x height = 12 x 5 = 60 ft^2

4. Area = base x height = 8 x 4 = 32 m^2

Differentiation Strategies

For Struggling Learners:

- Provide pre-drawn parallelograms with labels to help students visualize the problem.
- Use simpler numbers for base and height.
- Pair struggling students with confident problem solvers.
- Provide step-by-step calculation templates.
- Allow use of calculators.

For On-Level Learners:

- Encourage students to draw their own diagrams from word problems.
- Ask students to explain which formula they chose and why.
- Provide mixed practice with both direct calculation and finding missing dimensions.

For Advanced Learners:

- Challenge students to derive the formula themselves using the cut-and-rearrange method.
- Explore real-world applications: architecture, construction, engineering.
- Investigate the relationship between the area of a parallelogram and the area of a triangle.
- Apply the formula to find missing angles or sides when area is known.

Extension Activity

Real-World Application: Designing Parallelogram-Shaped Structures

Students work in groups to design a parallelogram-shaped structure (floor, billboard, solar panel) and calculate its area.

Materials: Graph paper, rulers, protractors, calculators

Tasks:

7. Choose a real-world structure that is parallelogram-shaped (floor, billboard, solar panel, etc.).
8. Draw the structure on graph paper with appropriate dimensions.
9. Measure the base and height.
10. Calculate the area using the formula Area = base x height.
11. If the perpendicular height is not given, use trigonometry to find it.
12. Present your findings to the class, explaining your methods and calculations.

Key Takeaway:

Students should understand how the area formula for parallelograms is used in real-world professions such as construction, architecture, and engineering to calculate areas of floors, walls, roofs, and other structures.

Teacher Reflection Prompts

- Did students successfully draw the parallelogram and drop the perpendicular in the anchor activity?
- Were students able to derive the formula Area = base x height?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did students understand when to use the perpendicular height versus the slant side?
- What adjustments would improve this lesson for future classes?