Grade 10 Mathematics Lesson Plan

Area of Trapeziums

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, rulers, protractors, pencils, scissors, calculators

Lesson Structure Overview

Phase	Duration	Focus
Problem-Solving and Discovery	15 minutes	Anchor activity: Exploring area of a trapezium through drawing and algebraic reasoning
Structured Instruction	10 minutes	Formalizing the formula: Area = (Base1 + Base2)/2 x height
Practice and Application	10 minutes	Worked example using coordinates
Assessment	5 minutes	Exit ticket to check understanding

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

Anchor Activity: Exploring Area of a Trapezium

Students work in groups to draw a trapezium, identify its parts (bases, legs, height), and discover the area formula by thinking about transforming the trapezium into a rectangle using the average of the two bases.

Materials Needed:

- Ruler
- Protractor

- Pencil
- Graph paper
- Scissors (optional)
- Calculator (optional)

Steps for the Activity:

1. Draw a Trapezium: On graph paper, draw a quadrilateral with one pair of opposite sides parallel (e.g., AB parallel to CD). Make sure the other pair (AD and BC) are not parallel. Label the trapezium as ABCD.
2. Identify the Parts: Label the bases (parallel sides). Label the legs (non-parallel sides). Draw the height (perpendicular distance between the two bases).
3. Now, let us break it down algebraically: Imagine the Area of a Rectangle: If we could transform the trapezium into a rectangle, the area of that rectangle would be the average of the two bases times the height. This works because the average length of the two parallel sides is a representative length for the trapezium, and multiplying it by the height gives us the correct area.
4. Mathematical Expression: The average length of the two parallel sides is given by: Average of bases = (Base1 + Base2) / 2. Therefore, the area of the trapezium is: Area = Average of bases x height = [(Base1 + Base2) / 2] x height. This is the formula for the area of a trapezium.
5. Understanding the Formula: The bases are the lengths of the parallel sides. The height is the perpendicular distance between the two bases. The average of the bases gives us a typical length for the trapezium, and when multiplied by the height, it gives the area, just like how you would calculate the area of a rectangle.

Teacher Role During Discovery:

- Circulate among groups, ensuring students understand how to draw a trapezium with one pair of parallel sides.
- Ask probing questions: What makes this shape a trapezium? How is it different from a parallelogram?
- For struggling groups: Let us draw the trapezium together. Only one pair of sides should be parallel.
- For early finishers: Can you derive the formula by thinking about the average of the two bases?
- Guide students to articulate: The average of the bases gives us a representative length.
- Identify 2-3 groups with clear algebraic reasoning to share with the class.

Phase 2: Structured Instruction (10 minutes)

Formalizing the Formula: Area = (Base1 + Base2) / 2 x height

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

Key Takeaway:

A trapezium is a four-sided polygon (quadrilateral) that has one pair of opposite sides that are parallel. These parallel sides are called the bases of the trapezium. The other two sides are not parallel and are called the legs.

Properties of a Trapezium:

- A trapezium looks like a bridge. Suggest other three real-life examples of trapeziums.
- One pair of sides are parallel (they never meet).
- The height is the straight-up distance between the parallel sides.
- The angles inside add up to 360 degrees.

Formula:

The area of a trapezium is given by:

Area = (a + b) / 2 x h

where a and b are the two parallel sides (bases) and h is the height.

Scaffolding Strategies to Address Misconceptions:

- Misconception: I can use any two sides. Clarification: No, you must use the two parallel sides (bases).
- Misconception: The height is one of the legs. Clarification: No, the height is the perpendicular distance between the two bases.
- Misconception: I add the bases and multiply by the height. Clarification: No, you must first find the average of the bases by dividing by 2.
- Misconception: A trapezium is the same as a parallelogram. Clarification: No, a trapezium has only one pair of parallel sides, while a parallelogram has two pairs.

Phase 3: Practice and Application (10 minutes)

Worked Example (Textbook Example 2.5.10):

Calculate the area of the figure below.

Solution:

The given figure is a trapezium with the following vertices:

- A(-2, 3)
- B(2, 3)
- C(3, -1)
- D(-3, -1)

From the diagram, we observe:

- The two parallel bases are AB and DC.
- The height is given as 4 cm, which is the perpendicular distance between the parallel bases.

Step 1: Determine the lengths of the bases

Length of AB: AB = $|x1 - x2| = |2 - (-2)| = |2 + 2| = 4$ cm

Length of DC: DC = $|x1 - x2| = |3 - (-3)| = |3 + 3| = 6$ cm

Step 2: Use the trapezium area formula

The area of a trapezium is given by:

Area = (1/2) x (Base1 + Base2) x Height

Substituting the values:

A = (1/2) x (4 + 6) cm x 4 cm

= (1/2) x 10 cm x 4 cm

= 20 cm squared

The area of the trapezium is 20 cm squared.

Phase 4: Assessment (5 minutes)

Exit Ticket:

Students complete the following questions individually.

1. A trapezium has a height of 5 cm, the top base is 8 cm and the bottom base is 14 cm. Find its area.

2. a) The bases of a trapezium are 12 cm and 6 cm and its area is 45 cm squared. Find the height. b) Find the missing angle in a trapezium where three angles are 70 degrees, 85 degrees and 95 degrees. c) A trapezium has equal non-parallel sides (legs). What special type of trapezium is this? d) The parallel sides of a trapezium are 20 m and 30 m and its height is 12 m. Find its area.

3. A trapezium-shaped farm has a shorter base of 150 m, a longer base of 300 m and a height of 200 m. Find the area of the farm.

4. A car window is shaped like a trapezium with a height of 50 cm, the top base is 60 cm and the bottom base is 80 cm. Find the area of the window.

5. A trapezoidal table has a top base of 1.2 m, a bottom base of 1.8 m and a height of 0.75 m. What is its surface area?

Answer Key:

1. Area = (1/2) x (8 + 14) x 5 = (1/2) x 22 x 5 = 55 cm squared.

2. a) 45 = (1/2) x (12 + 6) x h. 45 = (1/2) x 18 x h. 45 = 9h. h = 5 cm. b) Sum of angles = 360 degrees. Missing angle = 360 - (70 + 85 + 95) = 360 - 250 = 110 degrees. c) Isosceles trapezium. d) Area = (1/2) x (20 + 30) x 12 = (1/2) x 50 x 12 = 300 m squared.

3. Area = (1/2) x (150 + 300) x 200 = (1/2) x 450 x 200 = 45,000 m squared.

4. Area = (1/2) x (60 + 80) x 50 = (1/2) x 140 x 50 = 3,500 cm squared.

5. Area = (1/2) x (1.2 + 1.8) x 0.75 = (1/2) x 3.0 x 0.75 = 1.125 m squared.

Differentiation Strategies

For Struggling Learners:

- Provide pre-drawn trapeziums with bases and height already labeled.
- Use simpler numbers for base lengths and heights.
- 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 trapeziums from word problems.
- Ask students to explain which formula they chose and why.
- Provide mixed practice with both finding area and finding missing dimensions.

For Advanced Learners:

- Challenge students to derive the formula themselves using the concept of average bases.
- Explore real-world applications: architecture, bridge design, furniture design.
- Investigate the relationship between the area of a trapezium and other quadrilaterals.
- Apply the formula to find missing base lengths or height when area is known.

Extension Activity

Real-World Application: Designing Trapezium-Shaped Structures

Students work in groups to design a trapezium-shaped structure (bridge, table, window, farm) and calculate its area.

Materials: Graph paper, rulers, protractors, calculators, colored pencils

Tasks:

6. Choose a real-world application that uses trapezium shapes (bridge, table, window, farm, etc.).
7. Draw the trapezium on graph paper with appropriate dimensions.
8. Measure or specify the lengths of both bases and the height.
9. Calculate the area using the formula Area = (Base1 + Base2) / 2 x height.
10. Present your findings to the class, explaining your design choices and calculations.

Key Takeaway:

Students should understand how the area formula for trapeziums is used in real-world professions such as civil engineering, architecture, and furniture design to calculate areas of structures, bridges, and furniture pieces.

Teacher Reflection Prompts

- Did students successfully draw the trapezium and identify the parallel sides in the anchor activity?
- Were students able to discover the formula by thinking about the average of the bases?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did students understand when to use the trapezium formula versus other quadrilateral formulas?
- What adjustments would improve this lesson for future classes?