Grade 10 Mathematics Lesson Plan

Area of Irregular Polygons

Strand:	Measurement and Geometry
Sub-Strand:	Area of Polygons: Area of Irregular Polygons
Specific Learning Outcome:	Determine the area of irregular polygons 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, glue/tape, rulers, measuring tape, printed irregular polygons, calculators

Lesson Structure Overview

Phase	Duration	Focus
Problem-Solving and Discovery	15 minutes	Anchor activity: Dividing irregular polygons into smaller shapes
Structured Instruction	10 minutes	Formalizing the method 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: Dividing Irregular Polygons into Smaller Shapes

Objective: Students will discover that irregular polygons can be divided into smaller, familiar shapes (triangles, rectangles, trapeziums) to calculate their total area.

Materials Needed:

- Graph paper (preferably colored)
- Scissors
- Glue or tape

- Rulers
- Measuring tape (optional)
- A variety of irregular polygons (either printed or hand-drawn)

Steps for the Activity:

1. Step 1: Divide the Irregular Polygon. Work with a printed or drawn irregular polygon. The task is to divide the irregular polygon into smaller shapes whose areas are easier to calculate (like triangles, rectangles, or trapeziums). Tip: Use straight lines to cut along the diagonals or through the middle of the shape to create triangles or rectangles.
2. Step 2: Measure Necessary Dimensions. For each smaller shape, measure the necessary dimensions: For triangles, they need the base and height. For rectangles, they need the length and width. For trapeziums, they need the lengths of the two parallel sides and the height.
3. Step 3: Calculate the Area of Each Shape. Once the polygon is broken into smaller shapes, students can calculate the area of each shape using appropriate formulas.
4. Step 4: Add the Areas. Once the area of each smaller shape has been calculated, students should add up all the areas to find the total area of the original irregular polygon.

Discussion Questions:

5. What makes a polygon irregular?
6. How did you decide where to divide your polygon?
7. Did everyone divide their polygon the same way? Why or why not?
8. What formulas did you use to find the area of each smaller shape?

Teacher Role During Discovery:

- Circulate among groups, ensuring students understand how to divide the polygon strategically.
- Ask probing questions: Why did you choose to divide it this way? What shapes did you create?
- For struggling groups: Let us try dividing this polygon into two triangles first. Can you see where to draw the line?
- For early finishers: Can you find a different way to divide the same polygon? Do you get the same total area?
- Guide students to articulate: Irregular polygons can be broken into smaller shapes, and we add their areas to find the total.
- Identify 2-3 groups with different division strategies to share with the class.

Phase 2: Structured Instruction (10 minutes)

Formalizing the Method and Addressing Misconceptions

After students have completed the anchor activity and shared their findings, the teacher formalizes the method for finding the area of irregular polygons.

Key Takeaway: What Makes a Polygon Irregular

Regardless of shape, all polygons are made up of the same parts: sides, vertices, interior angles and exterior angles which may vary in size thus describing why we have irregular polygons versus regular polygons.

An irregular polygon has a set of at least two sides or angles that are not the same. This heptagon has many different size angles, making it irregular.

The interior angles of an irregular nonagon (9 sides) add up to 1,260 degrees. Because angles are different sizes, individual angles cannot be found from the sum of the interior angles.

Method for Finding Area of Irregular Polygons:

9. Divide the irregular polygon into smaller, familiar shapes (triangles, rectangles, trapeziums).
10. Measure the necessary dimensions for each smaller shape.
11. Calculate the area of each smaller shape using the appropriate formula.
12. Add all the areas together to find the total area of the irregular polygon.

Scaffolding Strategies to Address Misconceptions:

- Misconception: I can use a formula directly for irregular polygons. Clarification: No, there is no single formula. You must divide it into smaller shapes first.
- Misconception: There is only one correct way to divide the polygon. Clarification: No, there are multiple ways. As long as you divide it completely and accurately, you will get the same total area.
- Misconception: I need to find all the interior angles first. Clarification: No, you only need the dimensions (base, height, length, width) of the smaller shapes you create.
- Misconception: Irregular polygons do not have any patterns. Clarification: While sides and angles vary, the sum of interior angles still follows the formula (n minus 2) times 180 degrees.

Phase 3: Practice and Application (10 minutes)

Worked Example:

A farmer has land shaped like an irregular quadrilateral with sides measuring 50m, 60m, 40m and 30m. If the land is divided into two triangles for calculation, estimate its total area.

Solution:

Step 1: Divide the quadrilateral into two triangles by drawing a diagonal.

Step 2: For Triangle 1, assume base = 50m and height = 24m (measured perpendicular).

Area of Triangle 1 = (1/2) times base times height = (1/2) times 50 times 24 = 600 m squared

Step 3: For Triangle 2, assume base = 60m and height = 20m.

Area of Triangle 2 = (1/2) times 60 times 20 = 600 m squared

Step 4: Total Area = 600 + 600 = 1,200 m squared

Phase 4: Assessment (5 minutes)

Exit Ticket:

Students complete the following questions individually.

1. An irregular pentagon has the following side lengths: 5cm, 7cm, 6cm, 8cm and 4cm. If its total area is estimated using triangulation, determine its approximate area.

2. A garden is shaped like an irregular hexagon with side lengths 4m, 6m, 5m, 7m, 8m and 3m. Calculate its perimeter.

3. A farmer has land shaped like an irregular quadrilateral with sides measuring 50m, 60m, 40m and 30m. If the land is divided into two triangles for calculation, estimate its total area.

4. An office space has an irregular pentagonal shape with different side lengths and angles. The flooring cost is calculated based on the total area. If the room is divided into three triangles for estimation, find the approximate flooring cost given a rate of $25 per square meter.

5. A city park is designed in the shape of an irregular hexagon with measured sides of 20m, 25m, 30m, 28m, 22m and 18m. If the park area is estimated by splitting it into smaller triangles, find the total area.

Answer Key:

Note: Since exact heights are not provided, students should show their method and reasoning. Sample answers assume reasonable height measurements.

1. Divide into triangles, measure heights, calculate each area, sum them. (Answer will vary based on actual measurements)

2. Perimeter = 4 + 6 + 5 + 7 + 8 + 3 = 33 m

3. Divide into two triangles, calculate each area, sum them. Example: 600 + 600 = 1,200 m squared (assuming reasonable heights)

4. Divide into three triangles, calculate total area, multiply by $25. (Answer will vary based on actual measurements)

5. Divide into triangles, calculate each area, sum them. (Answer will vary based on actual measurements)

Differentiation Strategies

For Struggling Learners:

- Provide pre-divided polygons with shapes already outlined.
- Use simpler polygons that divide into only 2-3 shapes.
- Pair struggling students with confident problem solvers.
- Provide step-by-step calculation templates.
- Allow use of calculators.

For On-Level Learners:

- Encourage students to find multiple ways to divide the same polygon.

- Ask students to explain which division strategy is most efficient and why.
- Provide mixed practice with different types of irregular polygons.

For Advanced Learners:

- Challenge students to create their own irregular polygons and calculate the area.
- Explore real-world applications: land surveying, architecture, urban planning.
- Investigate the relationship between different division strategies and efficiency.
- Apply coordinate geometry to find areas of irregular polygons on a coordinate plane.

Extension Activity

Real-World Application: Land Surveying Project

Students work in groups to design an irregular plot of land and calculate its area for a real-world scenario (farm, park, building site).

Materials: Graph paper, rulers, measuring tape, calculators, colored pencils

Tasks:

13. Choose a real-world application that uses irregular polygon shapes (farm land, city park, building site, garden).
14. Draw the irregular polygon on graph paper with appropriate dimensions.
15. Divide the polygon into smaller shapes (triangles, rectangles, trapeziums).
16. Measure or specify the necessary dimensions for each smaller shape.
17. Calculate the area of each smaller shape.
18. Add all the areas together to find the total area.
19. Present your findings to the class, explaining your division strategy and calculations.

Key Takeaway:

Students should understand how the method for finding the area of irregular polygons is used in real-world professions such as surveying, architecture, and urban planning to calculate areas of land, buildings, and public spaces.

Teacher Reflection Prompts

- Did students successfully divide the irregular polygons into smaller shapes in the anchor activity?

- Were students able to discover that different division strategies yield the same total area?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did students understand when to use which formula for each smaller shape?
- What adjustments would improve this lesson for future classes?