I. Lesson Overview

Lesson Title:	Perfect Squares
Strand:	Numbers and Algebra
Sub-Strand:	Quadratic Expressions and Equations 1
Grade Level:	10
Estimated Duration:	40 minutes

Key Inquiry Question

How do we apply the concept of quadratic equations?

II. Learning Objectives & Standards

Learning Objectives

Upon completion of this lesson, students will be able to:

1. **Know (Conceptual Understanding):** Understand what perfect square trinomials are and recognize the two perfect square identities: $(a+b)^2$ and $(a-b)^2$.
2. **Do (Procedural Skill):** Expand perfect squares and factor perfect square trinomials using the identities.
3. **Apply (Application/Problem-Solving):** Use perfect square identities to simplify expressions and solve problems more efficiently.

Curriculum Alignment

Strand:	Numbers and Algebra
Sub-Strand:	Quadratic Expressions and Equations 1
Specific Learning Outcome:	Perfect Squares.

III. Materials & Resources

Textbooks:	CBC Grade 10 Mathematics Learner's Book CBC Grade 10 Mathematics Teacher's Book

IV. Lesson Procedure

Phase 1: Problem-Solving and Discovery / Engage & Explore (15 minutes)

Objective: To explore perfect square identities through collaborative discussion and discovery.

Anchor Activity: Exploring Perfect Squares

Work in groups to define, discuss, and work on the following:

1. Perfect square identities

2. Expanding perfect squares

3. Recognizing perfect square trinomials

4. Factoring perfect square trinomials

Copy and Observe:

Copy the following expressions and identities, observe and discuss:

(i) $(a + b)^2 = a^2 + 2ab + b^2$

(ii) $(a - b)^2 = a^2 - 2ab + b^2$

Key Observation: The middle term is TWICE the product of the two terms.

Discussion Questions:

- Compare the different approaches groups used to solve similar problems.
- Discuss how perfect square identities can make simplification and factoring easier.
- Explore how these identities are useful in different contexts (e.g., solving quadratic equations, simplifying expressions in algebra).
- How do perfect square identities help us solve quadratic expressions faster?
- What happens if we don't recognize the identity right away—how might that slow us down?
- Can you think of any real-world applications where you might use perfect square identities?

Teacher's Role: The teacher circulates among groups, asking probing questions (e.g., "Can you verify the identity by expanding?", "What do you notice about the middle term?", "How do you know if a trinomial is a perfect square?"). The teacher uses student discoveries to bridge to formal instruction.

Phase 2: Structured Instruction / Explain (10 minutes)

Objective: To formalize the perfect square identities and their applications.

Key Takeaways:

What is a Perfect Square?

A Perfect Square is a special kind of trinomial that can be factored into the square of a binomial. There are two forms of perfect square identities:

The Two Perfect Square Identities:

Identity	Expanded Form	Factored Form
1 (Positive)	$a^2 + 2ab + b^2$	$(a + b)^2$
2 (Negative)	$a^2 - 2ab + b^2$	$(a - b)^2$

When to Use Each Identity:

• Use the FIRST identity when the middle term is POSITIVE: $a^2 + 2ab + b^2 = (a + b)^2$

• Use the SECOND identity when the middle term is NEGATIVE: $a^2 - 2ab + b^2 = (a - b)^2$

How to Recognize a Perfect Square Trinomial:

A trinomial $a^2 + 2ab + b^2$ is a perfect square if:

1. The first term (a^2) is a perfect square

2. The last term (b^2) is a perfect square

3. The middle term equals 2 × √(first term) × √(last term)

Addressing Misconceptions: "Remember: Not every trinomial is a perfect square! You must check that the middle term is EXACTLY twice the product of the square roots of the first and last terms."

Phase 3: Practice and Application / Elaborate (15 minutes)

Objective: To apply perfect square identities to factor trinomials.

Worked Example: Factoring a Perfect Square Trinomial

Factor: $x^2 + 6x + 9$

Solution:

Step 1: Check if it's a perfect square

• First term: x^2 is a perfect square ($\sqrt{x^2} = x$)

• Last term: 9 is a perfect square ($\sqrt{9} = 3$)

• Middle term: $6x = 2 \times x \times 3 = 2ab$ ✓

Step 2: Identify a and b

• $a = x$ (square root of first term)

• $b = 3$ (square root of last term)

Step 3: Apply the identity

Since the middle term is positive, use $(a + b)^2$:

$x^2 + 6x + 9 = (x + 3)^2$

More Examples:

1. Factor: $x^2 - 10x + 25$

- $a^2 = x^2$, so $a = x$
- $b^2 = 25$, so $b = 5$
- Middle term: $-10x = -2(x)(5) = -2ab$ ✓
- Since middle term is negative: $(x - 5)^2$

2. Expand: $(2x + 5)^2$

$= (2x)^2 + 2(2x)(5) + 5^2$

$= 4x^2 + 20x + 25$

3. Factor: $4y^2 + 12y + 9$

- $a^2 = 4y^2$, so $a = 2y$
- $b^2 = 9$, so $b = 3$
- Middle term: $12y = 2(2y)(3) = 2ab$ ✓
- Result: $(2y + 3)^2$

Teacher's Role: The teacher monitors students, emphasizing the three-step check: "Is the first term a perfect square? Is the last term a perfect square? Is the middle term twice the product?"

Phase 4: Assessment / Evaluate (Exit Ticket)

Objective: To formatively assess individual student understanding.

Exit Ticket Questions:

1. Factor the following perfect square trinomials:

a) $x^2 + 8x + 16$

b) $x^2 - 14x + 49$

c) $9a^2 + 6a + 1$

2. Expand the following:

a) $(x + 4)^2$

b) $(3y - 2)^2$

3. Determine if the following is a perfect square trinomial. If yes, factor it:

$x^2 + 5x + 6$

4. A square tile has sides of length $(x + 2)$ cm. Write an expression for the area of the tile in expanded form.

5. Complete the square: $x^2 + 10x + \_\_\_ = (x + \_\_\_)^2$

Answer Key:

1. a) $x^2 + 8x + 16 = (x + 4)^2$

b) $x^2 - 14x + 49 = (x - 7)^2$

c) $9a^2 + 6a + 1 = (3a + 1)^2$

2. a) $(x + 4)^2 = x^2 + 8x + 16$

b) $(3y - 2)^2 = 9y^2 - 12y + 4$

3. $x^2 + 5x + 6$ is NOT a perfect square (middle term should be $2\times\sqrt{6}\times x \approx 4.9x$, not $5x$). It factors as $(x + 2)(x + 3)$.

4. Area $= (x + 2)^2 = x^2 + 4x + 4$ cm²

5. $x^2 + 10x + 25 = (x + 5)^2$

V. Differentiation

Student Group	Strategy & Activity
Struggling Learners (Support)	Scaffolding: Provide identity reference cards. Use color coding to highlight a^2, $2ab$, and b^2. Start with numerical examples (e.g., $4 + 4 + 1 = 9 = 3^2$). Allow peer support during practice.
On-Level Learners (Core)	The core lesson activities as described above.
Advanced Learners (Challenge)	Extension Activity: 1) Factor completely: $x^4 + 4x^2 + 4$ 2) If $(x + k)^2 = x^2 + 12x + c$, find k and c. 3) Use completing the square to solve: $x^2 + 6x + 5 = 0$

	4) Prove that $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ac$

Extension Activity Solutions:

1. $x^4 + 4x^2 + 4 = (x^2)^2 + 2(x^2)(2) + 2^2 = (x^2 + 2)^2$

2. $(x + k)^2 = x^2 + 2kx + k^2$

   Comparing: $2k = 12$, so $k = 6$

   And $c = k^2 = 36$

3. $x^2 + 6x + 5 = 0$

   $x^2 + 6x + 9 = 9 - 5 = 4$

   $(x + 3)^2 = 4$

   $x + 3 = \pm 2$

   $x = -1$ or $x = -5$

VI. Assessment

Type	Method	Purpose
Formative (During Lesson)	- Observation during group discussion - Questioning during exploration - Exit Ticket	To monitor progress and adjust instruction.
Summative (After Lesson)	- Homework assignment - Future quiz/test questions	To evaluate mastery of learning objectives.

Teacher's Role: Collect and review the exit tickets to gauge student understanding and identify any common misconceptions that need to be addressed in the next lesson.

VII. Teacher Reflection

To be completed after the lesson.

1. What went well?

2. What would I change?

3. Student Understanding: What did the exit tickets reveal?

4. Next Steps: Based on assessment data, what is the plan for the next lesson?