Subject Area	Mathematics
Grade Level	Grade 9
Strand	**Polynomials – Introduction to Polynomials**
Date and Length of lesson	October 17th, 2025 **Lesson 1/5**

Understanding by Design (UBD) Lesson Plan Template
(Adapted from Wiggins and McTighe)

Stage 1 – Desired Results

Learner Outcomes (GLO, SLO) to be taught in this lesson:

- Students will be able to define a polynomial and its components (terms, variables, coefficients, constants).
- Students will be able to identify terms of monomials, binomials, and trinomials.
- Students will be able to classify polynomials according to the number of terms and degree.
- Students will be able to arrange polynomials in descending order.
- Students will be able to model and represent polynomials using algebra tiles.

Describe one Big Idea for these learning outcomes:

Understanding the structure and properties of polynomials, including their terms, degree, and visual representations, empowers students to simplify more complicated algebraic expressions and helps them build a foundation for future advanced mathematical concepts.

"Polynomials are the building blocks of algebra. In later grades, you use polynomials to model situations in business, science, medicine and engineering" (Pearson, 2009, p.208).

Previous knowledge and possible student entry points:

- **Variables and Constants:**
  - Recognizing and understanding the difference between variables (symbols representing unknown values) and constants (fixed numerical values).
  - Example**:** Knowing that in the expression $3x + 5$, the x is a variable and the 5 is a constant.
- **Coefficients:**
  - Understanding that a coefficient is the numerical factor of a term containing a variable.
  - Example: Knowing that in the term $3x$, the 3 is the coefficient.
- **Exponents:**
  - Understanding exponents as a shorthand for repeated multiplication. For Example: $x^2 = x * x$).
  - Example: Understanding that x^3 means $x * x * x$.
- **Terms:**
  - Identifying terms as parts of an expression separated by addition or subtraction.
  - Example: Recognizing that in the expression $2x^2 + 3x - 4$, each of $2x^2$, $3x$, and then -4 are all individual terms in the expression.

- **Combining Like Terms:**
  - Simplifying expressions by adding or subtracting terms with the same variable and exponent (Example: $2x + 3x = 5x$, but $2x + 3x^2$ cannot be combined to a single term).
- **Basic Operations:**
  - Proficiency in basic arithmetic operations (addition, subtraction, multiplication, division) with integers and fractions.
- **Order of Operations:**
  - Understanding and applying the order of operations (PEMDAS/BODMAS):

PEMDAS:
- **P**arentheses (or brackets)
- **E**xponents (or orders/indices)
- **M**ultiplication
- **D**ivision
- **A**ddition
- **S**ubtraction

BODMAS:
- **B**rackets
- **O**rders (powers and square roots, etc.)
- **D**ivision
- **M**ultiplication
- **A**ddition
- **S**ubtraction

Concept Objectives	***Skill Objectives***

Students will know:
 	
• **The definition of a polynomial:** A polynomial is an expression consisting of variables and coefficients, involving only the operations of addition, subtraction, multiplication, and non-negative integer exponents.
• **The components of a polynomial:** Polynomials consist of terms, variables, coefficients, and constants.
• **The types of polynomials based on the number of terms:**
  o A monomial has one term.
  o A binomial has two terms.
  o A trinomial has three terms.
	Students will be able to:
	
	• **Identify a polynomial:** Given an algebraic expression, students will be able to determine whether it is a polynomial.
	• **Identify the terms of a polynomial:** Given a polynomial, students will be able to identify the individual terms, variables, coefficients, and constants.
	• **Classify a polynomial:** Given a polynomial, students will be able to classify it as a monomial, binomial, or trinomial based on the number of terms.

• **How to determine the degree of a polynomial:** The degree of a polynomial is determined by the highest exponent of the variable in any term. • **That polynomials are typically written in descending order:** Polynomials are often written in descending order, with the term with the highest degree appearing first. • **That there are many everyday connections with polynomials:** Such as yard sizing, garden sizes, costs of items in business, the height of a ball thrown into the air can be approximated by a quadratic polynomial.	• **Determine the degree of a polynomial:** Given a polynomial, students will be able to determine its degree. • **Arrange a polynomial in descending order:** Given a polynomial, students will be able to arrange its terms in descending order based on their exponents. • **Model and represent a polynomial using algebra tiles:** Students will be able to use algebra tiles to visually represent polynomial expressions. • **Assess real world applications of polynomials:** Students will be able to give examples on what and how polynomials can be used in their everyday lives for things that matter to them.

Stage 3 – Learning Plan

Instruction and Key Learning Activities

Learning Activities:
What learning experiences and instruction will enable students to achieve the desired results? How will the plan:

W = Help students to know **Where** the lesson is going and **What** is expected?

- Students will know *where* the lesson is going by the clear articulation of learning outcomes: Defining polynomials, identifying types, arranging in order, and modeling. Classify polynomials as monomial, binomial, or trinomial.
- Students will understand *why* this lesson is important through the "Big Idea" – Polynomials can model and solve problems. The teacher will start by providing examples like below of the area of a garden, which will help the student understand where the lesson is going and why it is relevant.

H = **Hook** all students and **Hold** their interest?

- Specific Example: The lesson starts with a picture/ diagram of a rectangular garden where the dimensions are expressed as variable expressions (length = x + 5, width = x + 2). The students will be asked: "If you were planning this garden, how would you express its area? What are the different parts of this expression?"
- Teacher Action: Project the garden image, lead a brief discussion about area, then pose the initial question. Encourage students to share ideas and sketches on mini whiteboards or in small groups.

E = Equip students, help them **Experience** the key concepts and **Explore** the new learning

- Introduce algebra tiles and models how each tile represents a term (x^2 tile, x tile, unit tile). Students will then use the tiles to build polynomial expressions like $x^2 + 4x + 3$. After students build this polynomial, teacher will model the expression $2x^2 + 3x + 1$ using algebraic tiles.
- Demonstrate the meaning of each tile. Provide time for exploration with guidance and prompts: "How would you represent 3x using these tiles? What does a negative x tile look like?" Gradually increase the complexity of the polynomials they are asked to model.

R = Provide opportunities to **Rethink** and **Revise** their understanding and work?

- After rearranging a set of polynomials in descending order, students swap their work with a partner and check each other's answers. If there are discrepancies, they must discuss and explain their reasoning to each other **(Check point: Formative Assessment for the Teacher).**
- Provide a clear answer key for self/peer checking. Facilitate discussions by asking probing questions: "Why did you choose to put that term first? What exponent did you look at?" Encourage students to justify their steps and correct mistakes based on their conversations.

E = Allow students to **Evaluate** their work and its implications?

- After practicing how to identify the parts of a polynomial, the teacher can ask all students to use their whiteboards and provide them with the equation $4x^2-2x + 5$ and then ask the students: What is the co-efficient? What is the degree? what is the constant? **(Check point: Formative Assessment for the Teacher).**
- Provide a clear answer key for self/peer checking.
- Facilitate discussions by asking probing questions and encourage students to justify their steps. Examples might be: “I noticed some of you wrote '2' as the coefficient of -2x. Why did you choose 2 instead of -2?" (Addresses a common mistake with negative signs). Also, “Why is '5' called the constant term? What makes it different from the other terms?" (Highlights the role of a constant).

T = Be **Tailored** to (personalized) to the different needs, interests, and abilities of the leaners?

- Group students of differing abilities in order - to help understand concepts. Use algebra tiles or provide more instruction to struggling learners.
- Assign the students to varying groups depending on ability. More instruction and algebra tiles may be used for some struggling learners.

O = Be **Organized** to maximize initial and sustained engagement as well as effective learning?

- Create a timer to help the lesson stay within a certain amount of time. Ask students to remain focused on each task while also making clear instructions and providing adequate time to complete those instructions.
- Ensure all instructions are clear. Explain to students the length of each segment of the lesson and ask that they follow along and remain focused on each new task.

Describe the possible entry points and prior knowledges for your lesson:

Entry Points:

- **Connections:**
  - Students may have encountered algebraic expressions in practical situations, like calculating areas, perimeters, or simple financial scenarios such as calculating total cost with variable quantities.
  - Starting with a relatable problem, such as the garden example, which provides a familiar context.
- **Visual Patterns and Sequences:**
  - Some students may be comfortable identifying patterns in numbers or shapes, which can be linked to the structure of polynomial expressions.
  - Use visual representations and models such as algebra tiles or diagrams, to highlight patterns in the terms and coefficients.
- **Hands-On Manipulation:**
  - Students who learn best through tactile experiences may be drawn to the hands-on manipulation of algebra tiles.
  - Emphasize the use of algebra tiles to physically represent and understand polynomial expressions.
- **Basic Algebraic Terminology:**
  - Some students might already be familiar with terms like "variable," "constant," "coefficient," and "exponent," even if their understanding is not fully developed.
  - Start by briefly reviewing these terms to ensure a common foundation before introducing more complex concepts.

Prior Knowledge:

Previous knowledge and possible student entry points:

Students should be familiar with basic algebraic concepts such as variables, constants, and exponents.

Students should know how to simplify expressions by combining like terms.

- **Variables and Constants:**
  - Understanding that a variable represents an unknown quantity and a constant is a fixed value.
  - Briefly quiz students: "Give an example of a variable." "Give an example of a constant." **(Check point: Formative Assessment for the Teacher).**
- **Exponents:**
  - Basic understanding of exponents as repeated multiplication (e.g., $x^2 = x * x$).
  - Ask: "What does x^3 mean?" **(Check point: Formative Assessment for the Teacher).**
- **Combining Like Terms:**
  - Ability to simplify expressions by combining terms with the same variable and exponent (e.g., $3x + 2x = 5x$).
  - Present a simple expression like $2x + 3 + x - 1$ and ask students to simplify it. **(Check point: Formative Assessment for the Teacher).**
- **Order of Operations:**
  - Familiarity with the order of operations (PEMDAS/BODMAS).
  - Ask what is the first step to solving $2x + 4 + 6x – 2$? Ask for answer to the different steps and ask for a thumbs up or down if student think that is correct **(Check point: Formative Assessment for the Teacher).**

How to Address Gaps in Prior Knowledge:

- **Quick Review:** Begin the lesson with a brief review of the necessary prior knowledge, providing examples and opportunities for students to ask questions.
- **Scaffolding:** Break down complex concepts into smaller, more manageable steps.
- **Differentiation:** Provide differentiated support and activities based on students' individual needs. For example, provide a reference sheet with definitions and examples for students who are struggling with the terminology.
- **Ongoing Assessment:** Continuously monitor students' understanding throughout the lesson and adjust instruction accordingly.

How will you *introduce* this lesson (rich task)?
What questions will you ask?
What will the students be doing during this introduction?

<u>Introducing the lesson:</u>

- Display a visually appealing image of a rectangular garden on the board/screen.
  - Briefly introduce the topic: "Today, we're going to explore a special type of algebraic expression called polynomials. They show up everywhere, from calculating areas to modeling growth! Here we see a picture of a garden".
  - A diagram of a garden with dimensions labeled as algebraic expressions (For example: length = x + 5, width = x).

Note: Other examples would be: A series of staircases made of blocks, increasing in height, or a table showing the cost of different items with varying quantities represented by variables.

Questions the Teacher will Ask:

- **(Connecting to Prior Knowledge):** Questions to ask: "Looking at this picture, what are some of the mathematical concepts that come to mind?" "What are some of the components that we see and how can we think about classifying different types of expressions for what you see?"
  - **Expected Student Responses:** Area, perimeter, variables, constants, expressions, patterns
  - **Purpose:** Activate prior knowledge and identify connections to previous lessons.
- **(Relating to Variables and Expressions):** "If 'x' represents an unknown, how would you write an expression for area and perimeter?"
  - **Expected Student Responses:** x, x+ 2, 2x + 1 …
  - **Purpose:** Identify connections to previous lessons.
- **(Introducing the Concept of Terms):** "Can you identify the individual 'parts' of this expression?"
  - **Expected Student Responses:** Some students may say, "x", and "+3".
  - **Purpose:** To start the conversation of how terms are parts of a Polynomial and how we can start naming them.
- **(Setting the Stage for Polynomials):** "What kind of things can you calculate using algebra/polynomials?"
  - **Expected Student Responses:** Garden size, costs of items, etc.
  - **Purpose:** Help students understand polynomials and make the material more engaging

Resources (Materials) required:

- PowerPoint: Polynomials 5.1
- Algebra tiles (physical or digital manipulative tool)
- White boards and math journals
- Textbook: Math Makes Sense 9 (pp.210-216).
- Exit slip (quick formative check)

***Describe the stages* of the lesson (the *during* part – anticipating knowledge progressions):**

1. **Defining Polynomials (15 minutes):**
   - Explicit Instruction: Use the slides to define polynomials, monomials, binomials, and trinomials.
   - Activity: Students work in pairs to identify examples of each type.
2. **Arranging Polynomials (15 minutes):**
   - Explicit Instruction: Use the slides to explain how to arrange polynomials in descending order.
   - Activity: Students practice rearranging polynomials in descending order.
3. **Modeling Polynomials with Algebra Tiles (20 minutes):**

- Explicit Instruction: Introduce algebra tiles and how they represent different terms.
- Activity: Model various polynomials using algebra tiles.
- Practice questions 11-15 on page 214-215.

4. **Textbook Questions:**
   - Assign textbook questions on page 214, 215 and 216.

***Possible wrap up plans* – even of the lesson does not conclude where you plan for the lesson to end):**

- **Recap Key Concepts:**
  - Quickly review the main points covered in the lesson: definition of polynomials, types of polynomials (monomials, binomials, trinomials), arranging in descending order, and representing polynomials with algebra tiles.
  - Summarize each concept, writing key terms on the board/screen while asking for input from students
- **"Exit Ticket":**
  - Ask students to write down the answers to one key questions on a small slip of paper (exit ticket):
    - "What is one thing you learned about polynomials today?"
    - "What is one question you still have about polynomials?"
  - Collect the exit slips as students leave the classroom as this will help to access their understanding and identify areas for review in the next lesson.

Reflection on this lesson:

What will come next in your planning for students' developing mathematically?
Building on this first introductory lesson, the next steps are to move on to operations with polynomials, which include the following:

- Adding and Subtracting Polynomials: Combining like terms to simplify expressions.
- Multiplying Polynomials: Using the distributive property to multiply polynomials of varying degrees (including binomials and trinomials).
- Dividing Polynomials: Introducing polynomial long division or synthetic division.
- Factoring Polynomials: Decomposing polynomials into simpler expressions.
- Solving Polynomial Equations: Finding the roots or solutions of polynomial equations.
- Graphing Polynomial Functions: Connecting algebraic expressions to their visual representations.

How does this task address the knowledge meaning making of the desired learning outcome (conceptual and skill knowledges)?

Conceptual Understanding:

Students develop a foundational understanding of what polynomials are, their components, and how to classify them. Using algebra tiles helps to conceptualize this abstract algebraic concept, helping students visualize and making the concept of polynomials more concrete.

Skill Development:

Students develop skills in identifying terms of a polynomial, variables, coefficients, and constants. They learn to arrange polynomials in descending order, which is a crucial skill for performing operations on polynomials and a building block for future lessons. Modeling polynomials with algebra tiles strengthens students' understanding of their structure.

Both conceptual and skill development in this lesson provides students with a fundamental foundation for future lessons. This knowledge helps students build a deeper understanding of polynomials and prepares them for more advanced mathematical tasks.

Strands of Mathematics Touched Upon in the Polynomials Unit:

- **Algebra**: Polynomials are fundamental algebraic expressions therefore this is the primary strand that we incorporate.
- **Number Sense and Operations**: Working with coefficients, exponents, and constants reinforces number sense and operational skills.
- **Patterns and Relationships:** Identifying patterns in polynomial expressions and their visual representations helps students develop pattern recognition skills.
- **Geometry**: Polynomials can be used to model geometric shapes and relationships such as area and volume.
- **Functions**: Polynomials are the building blocks of polynomial functions, which are essential in calculus and other higher-level math courses.

What I Have Learned in This Lesson Plan as part of my Unit Planning:

- A polynomial is one term or the sum of terms whose variables have a whole number exponents
- Classifying types of polynomials (monomials, binomials, trinomials)
- How to identify key aspects of a polynomial (terms, degree, coefficient, constant, variable)
- Applying the correct order of operations
- Real life applications of polynomials
- Modelling polynomials with tiles

References:

Dynamic Classroom Inc. (2021). *Dynamic Math: Grade 9 mathematics (AB edition).* Dynamic Classroom Inc.

Pearson Education Canada. (2009). *Math makes sense 9.* Pearson Education Canada.

Pearson Education Canada. (2009). *Math makes sense 9: Pro Guide - Unit 5: Polynomials.* Pearson Education Canada.