ABGS MIDDLE SCHOOL Unit Planner

ALGEBRA 1

UNIT 6 – Polynomials & Quadratic Functions

Teacher (s)	T. Moran D. Topping	**Subject Group and Discipline**	Advanced 8 Algebra 1		
Unit Title	Unit 6 Polynomials/Quadratic Functions	**MYP Year**	4	**Unit Duration**	**8 – 9 WEEKS**

INQUIRY? Establishing the purpose of the unit

Key Concept	Related Concept(s)	Global Context
Relationships	Simplification, Forms, and Equivalence	Identities and Relationships

Statement of Inquiry
Conceptual Understanding: Understanding the relationship between equivalent and forms of the expressions and the allowance for simplification. **Statement of Inquiry**: Establishing patterns in the natural world can help in understanding the simplification of relationships, identities and their forms and equivalence.

Inquiry Questions
Factual –How can you write quadratic expressions and functions in different but equivalent forms and what do the different forms tell you about the function's graph? **Conceptual** – How can we use properties to simplify and evaluate relationships? **Debatable** – How can one arrive at the same answer involving polynomials using different processes?

MYP OBJECTIVES	
NYS Next Generation Standards	**IB Objectives**
NY-8.F.3: Interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line. Recognize examples of functions that are linear and non-linear. e.g., The function $A = s^2$ given the area of a square as a function of its side length is not linear because its graph contains the points $(1, 1), (2, 4)$ and $(3, 9)$ which are not on a straight line. **Note**: **Function notation is not required in Grade 8.** **AI.A.APR.1**: Add, subtract, and multiply polynomials and recognize that the result of the operations is also a polynomial. This forms a system analogous to the integers. **Note**: **This standard is a fluency recommendation for Algebra I. Fluency in adding, subtracting, and multiplying polynomials supports students throughout their work in algebra as well as in their symbolic work with functions.** **AI-A.APR.3**: Identify zeros of polynomial functions when suitable factorizations are available. (Shared standard with Algebra II)	**Objective A**: Knowing and Understanding i. Students select appropriate mathematics when solving simple problems in familiar and unfamiliar situations. ii. Students apply the selected mathematics successfully when solving problems. iii. Students solve these problems correctly. **Objective B**: Investigating Patterns i. Students select and apply mathematical problem-solving techniques to discover complex patterns. ii. Students describe patterns as relationships and/or general rules consistent with correct findings. iii. Students verify and justify relationships and/or general rules.

Note: Algebra I task will focus on identifying the zeros of quadratic and cubic polynomial functions. For tasks that involve finding the zeros of cubic functions, the linear and quadratic factors of the cubic polynomial function will be given (e.g., find the zeros of $P(x) = (x-2)(x^2-9)$. **AI-A.SSE.1**: Interpret expressions that represent a quantity in terms of its context. * **AI.A.SSE.1a**: Write the standard form of a given polynomial and identify the terms, coefficients, degree, leading coefficient, and constant term. **AI.A.SSE.1b**: Interpret expressions by viewing one or more of their parts as a single entity. e.g., Interpret $P(1+r)^n$ as a product of P and a factor not depending on P. **Note**: This standard is a fluency expectation for Algebra I. Fluency in transforming expressions and chunking (seeing parts of an expression as a single object: is essential in factoring, completing the square and other mindful algebraic calculations. **AI-A.SSE.2**: Recognize and use the structure of an expression to identify ways to rewrite it. (Shared standard with Algebra II). e.g., $x^3 - x^2 - x = x(x^2 - x - 1)$ $53^2 - 47^2 = (53+47)(53-47)$ $16x^2 - 36 = (4x)^2 - (6)^2 = (4x+6)(4x-6) = 4(2x+3)(2x-3)$ or $16x^2 - 36 = 4(4x^2-9) = 4(2x+3)(2x-3)$ $-2x^2 + 8x + 10 = -2(x^2 - 4x - 5) = -2(x-5)(x+1)$ $x^4 + 6x^2 - 7 = (x^2+7)(x^2-1) = (x^2+7)(x+1)(x-1)$	**Objective C**: Communicating i. Students use appropriate mathematical language (notation, symbols, and terminology) in both oral and written explanations. ii. Students use appropriate forms of mathematical representation to present information. iii. Students move between different forms of mathematical representation. **Objective D**: Applying mathematics in real-life context. i. Students identify elements of authentic real-life situations. ii. Students select appropriate mathematical strategies when solving real-life situations. iv. Students explain the degree of accuracy of a solution. v. Students explain whether a solution makes sense in the context of the authentic real-life situation.

Note: **Algebra I expressions are limited to numerical and polynomial expressions in one variable. Use factoring techniques such as factoring out a greatest common factor, factoring the difference of two perfect squares, factoring trinomials of the form $ax^2 + bx + c$ with a lead coefficient of 1 or a combination of methods to factor completely.** Factoring will not involve factoring by grouping and factoring the sum and difference of cubes. **AI-A.SSE.3**: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (Shared standard with Algebra II) **AI-A.SSE.3c:** Use the properties of exponents to rewrite exponential expressions. (Shared standard with Algebra II) e.g., • $3^{2x} = (3^2)^x = 9^x$ • $3^{2x+3} = 3^{2x} \cdot 3^3 = 9^x \cdot 27$ **Note**: Exponential expressions will include those with integer exponents, as well as those whose exponents are linear expressions. Any linear term in those expressions will have an integer coefficient. **AI-N.RN.3**: Use properties and operations to understand the different forms of rational and irrational numbers. a) Perform all four arithmetic operations and apply properties to generate equivalent forms of rational numbers and square roots. **Note: Tasks include rationalizing numerical denominators of the form $\frac{a}{\sqrt{b}}$ where a is an integer and b is a natural number.** **AI-A.REI.4**: Solve quadratic equations in one variable. **Note**: Solutions may include simplifying radicals.	

AI-REI.4a: Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x-p)^2 = q$ that has the same solutions. Understand that the quadratic formula is a derivative of this process. **Note**: When utilizing the method of completing the square, the quadratic's leading coefficient will be 1 and the coefficient of the linear term will be limited to even (after the possible factoring out of a GCF). Students in Algebra I should be able to complete the square in which manipulating the given quadratic equation yields an integer value for q. **AI-REI.4b**: Solve quadratic equations by: i) inspection, ii) taking the square root, iii) factoring, iiii) completing the square, v) the quadratic formula, and vi) graphing. Recognize when the process yields no real solutions. (Shared standard with Algebra II) Notes: • **Solutions may include simplifying radicals or writing solutions in simplest radical form.** • An example for inspection would be $x^2 = 9$, where a student should know that the solutions would include 7 amd -7. • **When utilizing the quadratic formula, there are no coefficient limits.** • **The discriminant is a sufficient way to recognize when the process yields no real solutions.** **AI-A.REI.7a**: Solve a system, with rational solutions consisting of a linear equation and a quadratic equation (parabolas only) in	

two variables both algebraically and graphically. (Shared standard with Algebra II) **AI-A.REI.11**: Given the equations $y = f(x)$ and $y = g(x)$: i) recognize that each x −coordinate of the intersection(s) is the solution to the equation $f(x) = g(x)$. ii) find the solutions approximately using technology to graph the functions or make tables of values; and iii) **interpret the solution in context. *** (Shared standard with Algebra II) **Notes: Algebra I tasks are limited to cases where $f(x)$ and $g(x)$ are linear, polynomial, absolute value, and exponential functions of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0, (b \neq 1)$.** **Students should be taught to find the solutions approximately by using technology to graph the functions and by making tables of values. When solving any problem, students can choose either strategy.** **AI-F.IF.4**: For a function that models a relationship between two quantities: i) interpret key features of graphs and tables in terms of the quantities; and ii) sketch graphs showing key features given a verbal description of the relationship. (Shared standard with Algebra II) Notes: • Algebra I key features include the following: intercepts, **zeros**; intervals where the function is increasing, decreasing, positive or negative; maxima, minima; and symmetries. • Tasks have a real-world context and are limited to the following functions: linear, quadratic, square root, piece-wise defined (including step and absolute value)	

and **exponential functions of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$.** **AI-F.IF.7**: Graph functions and show key features of the graph by hand and by using technology where appropriate* (Share standard with Algebra II) AI-F.IF.7a: Graph linear, quadratic, and exponential functions and show key features. **Notes**: • Algebra I key features include the following: **intercepts, zeros; intervals where the function is increasing, decreasing, positive or negative; maxima, minima; and symmetries.** • **Exponential functions of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$.** **AI-F.IF.8**: Write a function in different but equivalent forms to reveal and explain different properties of the function. (Shared standard with Algebra II) **AI.F.IF.8a**: For a quadratic function, use an algebraic process to find zeros, maxima, minima, and symmetry of the graph and interpret these in terms of context. **Note: Algebraic processes include but not limited to factoring, completing the square, use of the quadratic formula and the use of the axis of symmetry.**	

Summative Assessment	Relationship Between Summative Assessment Task and Statement of Inquiry
Outline of summative assessment task(s) including assessment criteria: **Goal**: Establishing patterns can help in understanding how forms and their equivalences can simplify different situations in the real-world **Role**: You own an in-ground pool company, Lagoon Pools. **Audience**: Potential Customers **Situation**: A homeowner needed help designing a large, picturesque backyard that included a rectangle pool, a walkway around the pool and a hot tub within the pool close to the house. The homeowner gave the dimensions of the backyard, walkway, and hot tub in the form of binomials, The dimensions of the backyard are $(10x + 5)$ by $(15x + 6)$. The dimensions of the pool are $(6x + 4)$ by $(4x + 2)$. The dimensions of the walkway around the pool are $(2x)$ by $(6x + 4)$. The dimensions of the hot tub are $(2x)$ by $(x - 6)$. Using the information above: 1. Draw a model of the yard, not to scale, to depict the layout of the pool, walkway, and hot tub. 2. Calculate the area of the yard, pool, walkway, and hot tub. 3. Calculate the difference between the yard and the pool. 4. Calculate the difference between the walkway and the pool. 5. Calculate the difference between the pool and the hot tub. 6. Use the value of $x = 6$ to determine the area of the yard and the pool. 7. Determine the percentage of the yard that is represented by the pool. Determine the percentage of the pool that is represented by the hot tub.	Establishing patterns in the natural world can help in understanding the simplification of relationships, identities and their forms and equivalences. 8. By your calculations, is the owner correct to determine if the yard is large enough to put in the pool?

Approaches to Learning (ATL)
Thinking: Draw justifiable conclusion and generalizations from investigating patterns. Communication: Keep a regular journal during the investigation to maintain a record of reflections.

ACTION: Teaching and learning through inquiry

Content	Learning Process
Determine the relationship between polynomial expressions and integers. Perform arithmetic operations with polynomials including addition, subtraction and multiplication. Combine like terms. Apply the distributive property. Factor polynomials and include cubic polynomials. Recognize special products such as difference of two perfect squares (DOTS) and Perfect Square Trinomials (PST). Simplify radicals. Understand the effect the discriminant has on the roots of the quadratic equation. Determine the number of roots of the equation by the discriminant. Understand when a quadratic equation or function has no real solution. Solve quadratic equations by: inspection; taking the square root; factoring; quadratic formula; or completing the square. Understand the zeros of the quadratic equation are called: root; solutions; x −intercepts; x-values or the point where the graph crossed the x −axis. Rewrite the quadratic equation in vertex form.	**Learning Experiences and Teaching Strategies** Direct Instruction Group Activities Independent Practice Math Jeopardy

Determine the vertex of a quadratic equation by vertex form, formula for axis of symmetry $x = \frac{-b}{2a}$ or from a graph of the quadratic function. Graph quadratic functions using tables of values or technology.	
VOCABULARY Real Numbers — Parabola Distributive Property — Vertex $x = \frac{-b}{2q}$ Discriminant $b^2 - 4ac$ — Axis of Symmetry Radicals — Minimum Value Radicand — Maximum Value Index — x −intercept Standard Form of a Polynomial — Degree of a Polynomial Term — Variable Like Terms — Unlike Terms (GCF) Greatest Common Factor: (GMF) Greatest Common Monomial Factor) Perfect Square — No Real Solution Non-Perfect Square — Zeros, Roots, Solution Zero Product Property — Leading Coefficient Polynomial — Monomial Binomial — Trinomial Quadratic Equation — Quadratic Function Quadratic Formula $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ Factor — Complete the Square Area Model for Factoring — Diamond Method Factored Form — Vertex Form	**Formative Assessment** Quizzes Tests Homework Classwork Benchmark Algebra Common Core 1 Regent **Differentiation** TI-84 Graphing Calculator TI-30 Scientific Calculator Students' IEPs Real-Life Situations Student Options With Additional Teacher Support (AIS)

Resources		
Teacher Created Worksheets	Computer Based Worksheets & Activities	Algebra Teachers' Activity Book
Math Textbook	Delta Math	IXL
Brain-Pop	www.jmap.org	Problem-Attic
Teachers Pay Teachers	Kahn Academy	Kendrick Krause (YouTube)

REFLECTION: Considering the planning, process and impact of the inquiry

Prior to Teaching the Unit	During Teaching	After Teaching the Unit
Why do we think that the unit or the selection of topics will be interesting? What do students already know, and what can they do? What have students encountered in this discipline before? What does my experience tell me about what to expect in this unit? What attributes of the learning profile does this unit offer students opportunities to develop? What potential interdisciplinary connections can we identify? What do we know about my students' preferences and patterns of interaction? Are there any possible opportunities for meaningful service learning? What in the unit might be inspiring for community or personal projects? Could we develop authentic opportunities for service learning?	What difficulties did we encounter while completing the unit or the summative assessment task(s)? What resources are proving useful, and what other resources do we need? What student inquiries are emerging? What can we adjust or change? What skills need more practice? What is the level of student engagement? How can we scaffold learning for students who need more guidance? What is happening in the world right now with which we could connect teaching and learning in this unit? How well are the learning experiences aligned with the unit's objectives? What opportunities am I hearing to help students explore the interpretative nature of knowledge, including personal biases that might be retained, revised or rejected? (DP Theory of knowledge skills development)	What were the learning outcomes of this unit? How well did the summative assessment task serve to distinguish levels of achievement? Was the task sufficiently complex to allow students to reach the highest levels? What evidence of learning can we identify? What artefacts of learning should we document? Which teaching strategies were effective? Why? What was surprising? What student-initiated action did we notice? What will we do differently next time? How will we build on our experience to plan the next unit? How effectively did we differentiate learning in this unit?

How can we use my students' multilingualism as a resource for learning?		What can students carry forward from this unit to the unit? to the next year/ level of study? Which subject groups could we work with next time? What did we learn from standardizing the assessment?