Unit 3
Polynomials

Algebra II

Unit Description:

In this unit, students begin by writing and graphing higher degree polynomials that represent real-world situations. They will perform operations on polynomials; factor polynomials; identify the extrema, zeros/roots of polynomials, and intercepts; and study the end behavior of graphs of polynomial functions.

Standards for Mathematical Practice

MP.1 Make sense of problems and persevere in solving them.
MP.2 Reason abstractly and quantitatively.
MP.3 Construct viable arguments and critique the reasoning of others.
MP.4 Model with mathematics.
MP.5 Use appropriate tools strategically.
MP.6 Attend to precision.
MP.7 Look for and make use of structure.
MP.8 Look for and express regularity in repeated reasoning.

Louisiana Student Standards for Mathematics (LSSM)

The Louisiana Student Standards for Mathematics (LSSM), designates the following standards as A2: Algebra 2.
Italicized standards are designated as A1: Algebra 1 and are considered prerequisite standards for Algebra 2. While these prerequisite standards are present in the curriculum for scaffolding purposes, teachers will focus instruction on Algebra 2 expectations.

A-SSE: Algebra-Seeing Structure in Expressions	
A. Interpret the structure of expressions	
A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context. ★ **a.** Interpret parts of an expression, such as terms, factors, and coefficients. **b.** Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.*
A-SSE.A.2	Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$. *Include the factoring of the sum and difference of cubes.*
A-APR: Arithmetic with Polynomials and Rational Expressions	
A. Perform arithmetic operations on polynomials.	
A-APR.A.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

B. Understand the relationship between zeros and factors of polynomials	
A-APR.B.2	Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x-a$ is $p(a)$, so $p(a)=0$ if and only if $(x-a)$ is a factor of $p(x)$.
A-APR.B.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
C. Use polynomial identities to solve problems	
A-APR.C.4	Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity $(x^2+y^2)^2=(x^2-y^2)^2+(2xy)^2$ can be used to generate Pythagorean triples.*
D. Rewrite rational expressions	
A-APR.D.6	Rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form $q(x)+\frac{r(x)}{b(x)}$, where $a(x), b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
F-IF: Interpreting Functions	
B. Interpret functions that arise in applications in terms of the context.	
F-IF.B.4	For linear, piecewise linear (to include absolute value), quadratic, and exponential functions that model a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.* ★
F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* ★
C. Analyze functions using different representations.	
F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ **c.** Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
F-IF.C.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **a.** Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
F-IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in

	tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, determine which has the larger maximum.*
F-BF: Building Functions	
B. Build new functions from existing functions	
F-BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) \pm \boldsymbol{k}$, $\boldsymbol{k}\, f(x)$, $f(\boldsymbol{k}x)$, and $f(x \pm \boldsymbol{k})$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
Additional Standards for Honors Classes **N-CN.C.9 (+)** Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. **A-APR.C.5 (+)** Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.	

★As defined by LSSM, the basic modeling cycle involves:

1. identifying variables in the situation and selecting those that represent essential features,
2. formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables,
3. analyzing and performing operations on these relationships to draw conclusions,
4. interpreting the results of the mathematics in terms of the original situation,
5. validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable,
6. reporting on the conclusions and the reasoning behind them.

Choices, assumptions, and approximations are present throughout this cycle.

Enduring Understandings:	**Essential Questions:**
• Functions can be compared algebraically, graphically, in tables, or by verbal descriptions to make determinations about the key features. • Polynomial functions have identifiable intercepts and end behaviors. • The Quadratic Formula can be derived by completing the square on the standard form of a quadratic $ax^2 + bx + c$.	• How do you divide rational expressions? • How do you graph polynomial functions? • What is the remainder theorem? • How can polynomial functions be used to model real-world data?