Unit 4
Exponents, Radicals, and Polynomials

Algebra I

Unit Description:

Having studied linear relationships, students will now focus on exponent rules, nonlinear data, radical expressions, polynomial expressions/functions, and exponential functions (growth and decay). Additionally, students will factor polynomials that will be the foundation of working with quadratic functions in the next unit. Simplifying rational expressions will be introduced.

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)

N – Number and Quantity **RN – The Real Number System**	
B. Use properties of rational and irrational numbers.	
N-RN.B.3	Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
A – Algebra **SSE – Seeing Structure in Expression**	
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 $(x^2 - y^2)(x^2 + y^2)$, or see $2x^2 + 8x$ as $(2x)(x) + 2x(4)$, thus recognizing it as a polynomial whose terms are products of monomials and the polynomial can be factored as $2x(x + 4)$.
B. Write expressions in equivalent forms to solve problems.	
A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★ **a.** Factor a quadratic expression to reveal the zeros of the function it defines. ★ **b.** Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. ★ **c.** Use the properties of exponents to transform expressions for exponential functions emphasizing integer exponents. For example, the growth of bacteria can be modeled by either $f(t) = 3^{t+2}$ or $g(t) = 9(3^t)$ because the expression 3^{t+2} can be rewritten as $(3^t)(3^2) = 9(3^t)$.
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.
CED – Creating Equations	
A. Create equations that describe numbers or relationships.	
A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear, quadratic, and exponential functions. ★
A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. ★
F – Functions **IF – Interpreting Functions**	
A. Understand the concept of a function and use function notation.	
F-IF.A.3	Recognize that sequences are functions whose domain is a subset of the integers. Relate arithmetic sequences to linear functions and geometric sequences to exponential functions.
B. Interpret functions that arise in application 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. ★
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. ★ **a.** Graph linear and quadratic functions and show intercepts, maxima, and minima.
F-IF.C.8	(Standard is first addressed in this Unit.) 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. **b.** Graph piecewise linear (to include absolute value) and exponential functions.
LE – Linear, Quadratic, and Exponential Models	
A. Construct and compare linear, quadratic, and exponential models and solve problems.	
F-LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions. ★ **a.** Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. **b.** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **c.** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
F-LE.A.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). ★
B. Interpret expressions for functions in terms of the situation they model.	
F-LE.B.5	Interpret the parameters in a linear, quadratic, or exponential function in terms of a context.

★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:
	*How do parameters introduced in the context of the problem affect the symbolic, numeric and

*Quadratic functions, like linear and exponential, can be used to model real-life situations. *Properties of exponents can be extended to radical expressions rewritten in exponential form. *Factoring polynomial expressions can reveal information about quantities and find critical points of the function.	graphical representations of a quadratic function? *How can a given function be represented graphically, within a table, by an equation, and in the real-world? *What connections can be made between various functions and various representations of functions?