Unit F - *Exponential and Logarithmic Functions*

Overview

The purpose of this unit to expose students to ways of manipulating expressions using exponents. Students are expected to have a conceptual understanding of the rules around exponents and logarithms. They should explore the logic behind the development of negative exponents, zero as an exponent, and rational exponents. These should not just be taught as rules.

21st Century Capacities: Analyzing

Stage 1 - Desired Results

ESTABLISHED GOALS/ STANDARDS		
MP2 Reason abstractly and quantitatively **MP7** Look for and make use of structure CCSS.MATH.CONTENT.HSN.RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. CCSS.MATH.CONTENT.HSN.RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents. CCSS.MATH.CONTENT.HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. CCSS.MATH.CONTENT.HSA.SSE.A.2 Use the structure of an expression to identify ways to rewrite it. CCSS.MATH.CONTENT.HSA.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*		

Transfer:

Students will be able to independently use their learning in new situations to...

1. Manipulate equations/expressions or objects to create order and establish relationships. (Analyzing)
2. Demonstrate fluency with math facts, computation and concepts.

Meaning:

UNDERSTANDINGS: *Students will understand that:*	ESSENTIAL QUESTIONS: *Students will explore & address these recurring questions:*
1. Mathematicians create or use models to examine, describe, solve. 2. Mathematicians can describe patterns, relations, and/or functions to access strategies to solve problems. 3. Mathematicians represent and analyze mathematical situations and structures using algebraic symbols to communicate thinking.	A. How can I break a problem down into manageable parts? B. What math tools/models/strategies can I use to solve the problem? C. How can I simplify the problem? D. How can I use symbols to communicate?

CCSS.MATH.CONTENT.HSA.SSE.B.3.C Use the properties of exponents to transform expressions for exponential functions. CCSS.MATH.CONTENT.HSA.SSE.B.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. CCSS.MATH.CONTENT.HSA.REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. CCSS.MATH.CONTENT.HSA.REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). CCSS.MATH.CONTENT.HSF.IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. CCSS.MATH.CONTENT.HSF.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. CCSS.MATH.CONTENT.HSF.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.[*] CCSS.MATH.CONTENT.HSF.IF.C.7.E Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. CCSS.MATH.CONTENT.HSF.IF.C.8.B Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^{t}/10$, and classify them as representing	*Acquisition:*	
	Students will know…	*Students will be skilled at…*
	1. Know the properties of exponents and why they work 2. That with C > 0 if a>1 the function represents growth and if $0 < a < 1$ the function represents decay 3. The definition of a log 4. Common logarithmic function has base 10, natural log has base e 5. The Product, Quotient and Power Properties of logarithms 6. Vocabulary: index, argument, logarithm, base, decay,	1. Simplifying expressions using the properties of exponents 2. Using $y = Ca^x$ type equations to graph exponential growth and decay and solve application problems 3. Using $a = P(1 + r/n)^{nt}$ to solve compound interest problems 4. Identifying if a relationships is exponential or linear 5. Converting between radical notation and rational exponent notation 6. Solving radical equations 7. Converting between exponential and logarithmic form 8. Sketching graphs of logarithmic functions 9. Using logarithms to solve equations and in applications

exponential growth or decay.

CCSS.MATH.CONTENT.HSF.BF.A.1 Write a function that describes a relationship between two quantities.[*]

CCSS.MATH.CONTENT.HSF.BF.A.1.A Determine an explicit expression, a recursive process, or steps for calculation from a context.

CCSS.MATH.CONTENT.HSF.BF.B.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

CCSS.MATH.CONTENT.HSF.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.

CCSS.MATH.CONTENT.HSF.LE.A.1.A Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

CCSS.MATH.CONTENT.HSF.LE.A.1.C Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

CCSS.MATH.CONTENT.HSF.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).

CCSS.MATH.CONTENT.HSF.LE.A.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

CCSS.MATH.CONTENT.HSF.LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.