Unit C - *Exponential and Logarithmic Functions*

Overview

This unit covers the basic properties of exponential and logarithmic functions. Students will be graphing and solving exponential and logarithmic functions. Students will also model "real world" situations with exponential and logarithmic functions.

21st Century Capacities: Synthesizing, Analyzing

Stage 1 - Desired Results

ESTABLISHED GOALS/ STANDARDS

MP 1 Make sense sense of problems and persevere in solving them
MP2 Reason abstractly and quantitatively
MP4 Model with Mathematics
MP5 Use appropriate tools strategically

CCSS.MATH.CONTENT.HSA.SSE.B.3.C
Use the properties of exponents to transform expressions for exponential functions.
CCSS.MATH.CONTENT.HSN.RN.A.2
Rewrite expressions involving radicals and rational exponents using the properties of exponents.
CCSS.MATH.CONTENT.HSA.SSE.A.1
Interpret expressions that represent a quantity in terms of its context.*
CCSS.MATH.CONTENT.HSA.CED.A.2
Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
CCSS.MATH.CONTENT.HSA.REI.D.11
Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions

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.
3. Use appropriate tools to make reaching solutions more efficient, accessible and accurate. (Synthesizing)

Meaning:

UNDERSTANDINGS: *Students will understand that:*

1. The numerical, algebraic and graphic representation all represent the same situation.
2. Mathematicians apply the mathematics they know to solve problems occurring in everyday life.
3. Mathematicians create or use models to examine, describe, solve and/or make predictions.

ESSENTIAL QUESTIONS: *Students will explore & address these recurring questions:*

A. Does this solution make sense?
B. How can I use what I know to help me find what is missing?
C. What do I need to support my answer?
D. How can a variable/ expression / equation/graph tell a story?

	Acquisition:	
approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* CCSS.MATH.CONTENT.HSF.IF.B.4 For a function that models 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. CCSS.MATH.CONTENT.HSF.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. 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 exponential growth or decay. CCSS.MATH.CONTENT.HSF.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). CCSS.MATH.CONTENT.HSF.BF.A.1 Write a function that describes a relationship between two quantities.* CCSS.MATH.CONTENT.HSF.BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ 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.	*Students will know…* 1. One to one functions 2. The horizontal line test 3. A function and its inverse are mirror images over the y=x line 4. The base of an exponential function must be greater than 0 and less than 1 and why 5. Definition of a logarithm 6. The range of a function is the domain for the inverse, the domain of a function is the range of the function (and visa versa) 7. You can't take the log of 0 and why 8. The product and quotient rule for exponents and logarithms 9. Change of base rule for logs 10. The Power Rule of exponents and logarithms 11. What e is and its value 12. Vocabulary: minima, maxima, symmetry, domain, range, inverse functions, common logarithms, natural logarithms, doubling time, half-life, compounded	*Students will be skilled at…* 1. Determining whether a function is one to one by analyzing graphs 2. Determining the inverse of a 1 to 1 function 3. Graphing the inverse of a function 4. Determining if two functions are inverses 5. Graphing exponential functions using a table and then using transformations 6. Determine the domain and range of an exponential function 7. Graph exponential functions with base e 8. Graphing logarithmic functions 9. Find the domain and range of a logarithmic function 10. Fluently converting exponential functions to logarithmic functions 11. Using logarithmic rules to simplify expressions 12. Converting between exponential and logarithmic form of an equation 13. Modeling compound interest, decay and growth using exponential and logarithmic functions 14. Use logarithmic rules to solve logarithmic equations 15. Solving exponential and logarithmic equations using a graphing calculator. 16. Using exponential and logarithmic functions to model

CCSS.MATH.CONTENT.HSF.BF.B.4 Find inverse functions. CCSS.MATH.CONTENT.HSF.BF.B.4.B (+) Verify by composition that one function is the inverse of another. CCSS.MATH.CONTENT.HSF.BF.B.4.C (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. 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.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. 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.		