Unit G - *"Growth and Decay" - Understanding Exponential Functions*

Overview

This unit builds on concepts of a function and patterns of change as students work with interesting and significant relationships that are exponential in nature. Students study rules of exponents and develop meaning for negative and rational exponents. Then they will apply those rules to exponential functions. Students will transform functions as they did with linear, quadratic, and absolute value models. When comparing an exponential model with a linear model, the question is not *if* the exponential model will generate very large or very small inputs, but rather *when*. Students will gain an appreciation for the power of mathematics in identifying and addressing solutions and making predictions and decisions about significant real world problems.

21st Century Skills: Product Creations, Synthesizing

Stage 1 - Desired Results

ESTABLISHED GOALS/ STANDARDS

MP4 Model with Mathematics
MP5 Use appropriate tools strategically
MP7 Look for and make use of structure

A.SSE.1b. Interpret complicated expressions by viewing one or more of their parts as a single entity.
N.RN.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.
N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple

Transfer:

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

1. Model relationships among quantities. (synthesizing)
2. Manipulate expressions to create order and establish relationships. (product creation)
3. Draw conclusions about graphs, shapes, equations, or objects. (synthesizing)
4. Justify reasoning using clear and appropriate mathematical language. (product creation)

Meaning:

UNDERSTANDINGS: *Students will understand that:*

1. When comparing an exponential model with a linear model, the exponential model will eventually generate very large or very small inputs
2. Mathematicians create or use models to examine, describe, solve and/or make

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

A. What are the similarities and differences between linear, quadratic and exponential functions?
B. How do changes to the parent quadratic/absolute function change the

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<td rowspan="3">cases and using technology for more complicated cases.★e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
F.BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.★
F.LE.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
F.LE.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).
F.LE.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.
F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.
A-SSE3c. Use the properties of exponents to transform expressions for exponential functions
F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. b. Use the properties of exponents to interpret expressions for exponential functions.</td>
<td>predictions.
3. Mathematicians argue the relationships between problem scenarios and mathematical representation.</td>
<td>graph?
C. What can the characteristics of an exponential function tell you about real world events?
D. What is another way to represent this?</td>
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<td colspan="2">Acquisition:</td>
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<td>Students will know…

1. $y = ar^x$ and/or $y = ab^x$
2. The effects of parameters on an exponential function
3. $a^m a^n = a^{m+n}$
4. $a^m/a^n = a^{m-n}$
5. $(a^m)^n = a^{mn}$
6. $\sqrt{a} = a^{1/2}$
7. Applications such as compound interest, doubling time, half life
8. Applications to geometry including area and volume
9. Vocabulary: exponential, decay,</td>
<td>Students will be skilled at…

1. Distinguishing between linear, exponential and quadratic growth in tables, graphs or equations;
2. Write a recursive or explicit rule for an exponential function;
3. Using exponent rules to simplify expressions
4. Rational exponents;
5. Using a recursive feature of a graphing calculator to model exponential growth;
6. Distinguishing between exponential growth and decay in real world situations;
7. Describing the effects of the parameters in exponential functions;
8. Fitting an exponential function to a set of data;
9. Determining the growth or decay factor and writing an explicit equation for an exponential function;
10. Determining the percent rate of change and the growth or decay factor.</td>
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