UbD: Algebra 1 - Introduction to Exponential Functions

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<tr><td>Time Frame: 21 Lessons</td><td>Unit 5: Introduction to Exponential Functions</td><td>Course Name: Algebra 1</td></tr>
<tr><td colspan="3">Stage 1: Desired Results</td></tr>
<tr><td>Established Goal(s)</td><td colspan="2">Transferable Skills</td></tr>
<tr><td rowspan="3">Competencies Addressed:
Introduction to Exponential Functions

Standards:
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
HSA-SSE.B.3.c Factor a quadratic expression to reveal the zeros of the function it defines.
HSF-BF.A.1.a Determine an explicit expression, a recursive process, or steps for calculation from a context.
HSF-IF.C.7.e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.
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.
HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that</td><td colspan="2">Students will be able to independently use their learning to...

● discover exponential relationships are characterized by a constant quotient over equal intervals, and compare them to linear relationships which are characterized by a constant difference over equal intervals.
● develop clear and effective communication.
● increase self-direction.
● develop creative and practical problem-solving.
● become responsible and involved citizens.
● develop informed and integrative thinking.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td><u>Understandings</u>
Students will understand that...
● Exponents are used to represent complex expressions.
● Linear functions have a constant difference, whereas exponential functions have a constant ratio.
● Real world situations can be represented symbolically and graphically.</td><td><u>Essential Questions</u>

● How can you simplify expressions involving exponents
● What characterizes exponential growth and decay?
● What are real world models of exponential growth and decay?
● How can one differentiate an exponential model from a linear model given a real world set of data?</td></tr>
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	Acquisition	
use function notation in terms of a context. **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. **HSF-IF.B.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. **HSF-IF.B.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. **HSF-IF.C.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **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 $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay. **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	*Students will know...* • for a numerical or categorical data set, the distribution tells you how many of each value or each category there are in the data set. • the five-number summary of a data set consists of the minimum, the three quartiles, and the maximum. • identify the growth or decay factor for a given exponential function; write exponential functions for a given situation and use them to solve problem • use words and expressions to describe patterns in tables of values. • when there are descriptions of linear and exponential relationships, they can write expressions and create tables of values to represent them.. • use only multiplication to represent "decreasing a quantity by a fraction of itself." • write an expression or equation to represent a quantity that decays exponentially. • find a growth factor from a graph and write an equation to represent exponential decay. • graph equations that represent quantities that change by a growth factor between 0 and 1. • write and graph an equation that represents exponential decay to solve problems. • use function notation to write equations that represent exponential relationships • analyze a situation and determine whether it makes sense to connect the points on the graph that represents the situation.. • calculate the average rate of change of a function over a specified period of time. • know how the average rate of change of an exponential function differs from that of a linear function.	*Students will be able to...* • numerical data are responses to questions that are numbers that can be ordered in a natural way. • categorical data are responses to questions that fit into distinct categories. • evaluate exponential expressions for a given value of the variable. • apply the properties of exponents to simplify expressions. • compare growth patterns using calculations and graphs. • use zero and negative exponents, multiplication properties exponents, and division properties of exponents. • apply the properties of exponents to simplify and solve problems using scientific notation. • evaluate exponential functions for a given domain. • identify and graph exponential functions. • explain the connections between an equation and a graph that represents exponential growth. • describe the meaning of a negative exponent in equations that represent exponential decay. • write and interpret an equation that represents exponential growth. • expain the meanings of "exponential growth" and "exponential decay. • use graphs to compare and contrast situations that involve exponential decay. • use information from a graph to write an equation that represents exponential decay. • determine whether the relationships are functions when veiwing relationships in descriptions, tables, equations, or graphs.

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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). **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.** **HSN-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **HSS-ID.B.6.a** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.	• determine an appropriate model for the situation described by the data. • describe the effect of changing and on a graph that represents . • explain the meaning of the intersection of the graphs of two functions in terms of the situations they represent. • know two points on a graph of an exponential function, and be able to write an equation for the function. • find the result of applying a percent increase or decrease on a quantity. • write different expressions to represent a starting amount and a percent increase or decrease. • write a numerical expression or an algebraic expression to represent the result of applying a percent increase repeatedly. • explain why applying a percent increase, *p, n* times is like or unlike applying the percent increase *pn*. . • calculate interest when I know the starting balance, interest rate, and compounding intervals. • solve problems using exponential expressions written in different ways. • write equivalent expressions to represent situations that involve repeated percent increase or decrease. • calculate rates of change of functions given graphs, equations, or tables. • determine whether to use a linear function or an exponential function to model real-world data.	• make sense of and describe the relationship using function notation when shown a graph of an exponential function. • use exponential functions to model situations that involve exponential growth or decay. • use equations and graphs to compare exponential functions. • use graphs to illustrate and compare different percent increases. • choose the better investment option when given interest rates and compounding intervals. • use tables, calculations, and graphs to compare growth rates of linear and exponential functions and predict how the quantities change eventually. • use rates of change to describe how a linear function and an exponential function change over equal intervals. • determine how well a chosen model fits the given information. Mathematical Practices: • make sense of problems and persevere in solving them. • reason abstractly and quantitatively. • construct viable arguments and critique the reasoning of others. • model with mathematics. • use appropriate tools strategically. • attend to precision. • look for and make use of structure. • look for and express regularity in repeated reasoning.