

UbD: Algebra 1 - Introduction to Exponential Functions

Time Frame: 21 Lessons	Unit 5: Introduction to Exponential Functions	Course Name: Algebra 1
Stage 1: Desired Results		
Established Goal(s)	Transferable Skills	
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	<i>Students will be able to independently use their learning to...</i> ● 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.	
	Meaning	
	<u>Understandings</u> <i>Students will understand that...</i> ● 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.	<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?

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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

Acquisition

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.
- explain 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 viewing 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 a and b 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.