Math I UNIT 4 OVERVIEW: Exponential Functions

Unit Outcomes At the end of this unit, your student should be able to:	**Key Vocabulary** Terms to deepen the student's understanding
• Classify exponential functions as growth or decay • Compare/contrast properties and the graphs of linear and exponential functions • Construct a graph of an exponential function from a table, sequence or a situation • Model an exponential relationship between two quantities with tables, graphs, and equation • Recognize that the solutions to an exponential equation are represented by the points on the graph • Understand that a geometric sequence is a sequence of numbers where the ratio between consecutive numbers is constant • Understand that an exponential function has a *r* value greater than 1 if the function is growing • Identify the common ratio of the sequence • Write the first and subsequent terms of the sequence • Evaluate functions for given domains • Recognize a pattern will allow them to determine an arithmetic or geometric model • Translate between the recursive (NOW/NEXT) and explicit forms in modeling situations • Construct a table and graph of a linear function with slope m and exponential rate of change equal to the slope to identify the point where the exponential function exceeds the linear function • Determine the difference between the rate of change of a linear model (add each time) versus an exponential model (multiply each time)	• Base • Common Ratio • Constant • Explicit Form • Exponent • Exponential Decay • Exponential Equation • Exponential Form • Exponential Function • Exponential Growth • Function Notation • Geometric Sequence • Horizontal and Vertical Translation • Initial Term • Intercepts • Intervals Where Increasing, Decreasing, Positive or Negative • NOW-NEXT • Rate of Change • Relative Maximum • Relative Minimum

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Key Standards Addressed Connections to Common Core/NC Essential Standards	**Where This Unit Fits** Connections to prior and future learning
NC.M1.N-RN.2 Rewrite algebraic expressions with integer exponents using the properties of exponents. **NC.M1.A-SSE.1a** Interpret expressions that represent a quantity in terms of its context. a. Identify and interpret parts of a linear, exponential, or quadratic expression, including terms, factors, coefficients, and exponents. **NC.M1.A-SSE.1b** Interpret a linear, exponential, or quadratic expression made of multiple parts as a combination of entities to give meaning to an expression. **NC.M1.A-CED.2** Create and graph equations in two variables to represent linear, exponential, and quadratic relationships between quantities. **NC.M1.A-REI.11** Build an understanding of why the x-coordinates of the points where the graphs of two linear, exponential, and/or quadratic equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$ and approximate solutions using graphing technology or successive approximations with a table of values. **NC.M1.F-IF.2** Use function notation to evaluate linear, quadratic, and exponential functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **NC.M1.F-IF.3** Recognize that recursively and explicitly defined sequences are functions whose domain is a subset of the integers, the terms of an arithmetic sequence are a subset of the range of a linear function, and the terms of a geometric sequence are a subset of the range of an exponential function. **NC.M1.F-IF.4** Interpret key features of graphs, tables, and verbal descriptions in context to describe functions that arise in applications relating two quantities, including: intercepts; intervals where the function is increasing, decreasing, positive, or negative; and maximums and minimums.	**Coming into this unit, students should have a strong foundation in:** • Solving one variable equations • Graphing linear functions • Identifying the initial value for a linear function • Writing recursive and explicit forms of an equation • Identifying key features of a function from a graph • Simplify expressions using exponents • Investigating the laws of who number exponents. **This unit builds to the following future skills and concepts:** • Solving quadratic equations • Graphing and analyzing more complex functions (including inverse, step, exponential, absolute value, trigonometric and logarithmic functions) • Using regression models to predict linear, quadratic and exponential models

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NC.M1.F-IF.5 Interpret a function in terms of the context by relating its domain and range to its graph and, where applicable, to the quantitative relationship it describes. **NC.M1.F-IF.6** Calculate and interpret the average rate of change over a specified interval for a function presented numerically, graphically, and/or symbolically. **NC.M1.F-IF.7** Analyze linear, exponential, and quadratic functions by generating different representations, by hand in simple cases and using technology for more complicated cases, to show key features, including: domain and range; rate of change; intercepts; intervals where the function is increasing, decreasing, positive, or negative; maximums and minimums; and end behavior. **NC.M1.F-IF.8b** Use equivalent expressions to reveal and explain different properties of a function. b). Interpret and explain growth and decay rates for an exponential function. **NC.M1.F-IF.9** Compare key features of two functions (linear, quadratic, or exponential) each with a different representation (symbolically, graphically, numerically in tables, or by verbal descriptions). **NC.M1.F-BF.1a** Write a function that describes a relationship between two quantities. a. Build linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two ordered pairs (include reading these from a table). **NC.M1.F-BF.1b** Build a function that models a relationship between two quantities by combining linear, exponential, or quadratic functions with addition and subtraction or two linear functions with multiplication. **NC.M1.F-BF.2** Translate between explicit and recursive forms of arithmetic and geometric sequences and use both to model situations. **NC.M1.F-LE.1** Identify situations that can be modeled with linear and exponential functions, and justify the most appropriate model for a situation based on the rate of change over equal intervals. **NC.M1.F-LE.3** Compare the end behavior of linear, exponential, and quadratic functions using graphs and tables to show that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically**.** **NC.M1.F-LE.**5 Interpret the parameters a and b in a linear function f(x) = $ax + b$ or an exponential function $g(x)$ = abx in terms of a context. **NC.M1.S-ID.6** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. **c** Fit a function to exponential data using technology. Use the fitted function to solve problems.	

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Additional Resources Materials to support understanding and enrichment	**"Learning Checks"** Questions Parents Can Use to Assess Understanding
• Teaching Videos made by Wake County teachers • Exponential Growth and Decay • Modeling exponential growth and decay (video) • Graphing exponential functions (practice) • Evaluating exponential functions (practice) • Geometric sequences overview (video) • Write explicit form of geometric sequences (practice)	• What considerations should be taken into account when determining the boundaries and scales of a graph? • What are the key features of an exponential function? • When given one of the four forms of information, what should be taken into consideration when determining the best function to model the situation? • How do you determine the best model for a data pattern? • Why is a multiplicative rate of change the key feature of an exponential function and how is it revealed in the different forms of this function (verbal, graph, table, equation)? • When given a sequence, how do you identify whether it is arithmetic or geometric and how do you write a rule for the sequence? • What does compound interest look like in the real world? • How is the half-life of a radioactive element used to determine how much of a sample is left after a given period of time? • How do exponential functions model real-world problems and their solutions?