WAKE COUNTY PUBLIC SCHOOL SYSTEM

Middle School Programs
Building Healthy Core Learning
Common Core Math I, Unit 4

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
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 ✓ Solving systems of equations and inequalities through graphing, substitution and elimination **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 $g(x) = ab$x 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.

NC.M1.S-ID6c 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
✓ 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?

*** Please note**, the unit guides are a work in progress. If you have feedback or suggestions on improvement, please feel free to contact wakemiddle@wcpss.net.