# GSE Algebra

## Unit Four Information

Georgia Milestones Domain & Weight: Functions 35%, Equations 30%

Curriculum Map: Modeling and Analyzing Exponential Functions

Content Descriptors:

Concept 1: Create Equations / Geometric Sequences
Concept 2: Graphing and Characteristics of Exponential Functions
Concept 3:Application and Multiple Representations

Content from Frameworks: Modeling & Analyzing Exponential Functions

Unit Length: Approximately 20 days

Georgia Milestones Study Guide for Modeling & Analyzing Exponential Functions

# GSE Algebra I Unit 4
# Curriculum Map

***Unit Rational:***
Students will analyze exponential functions only. Students will (1) investigate key features of graphs; (2) create, solve, and model graphically exponential equations; (3) recognize geometric sequences as exponential functions.

| ***Prerequisites: As identified by the GSE Frameworks*** | ***Length of Unit*** |
|---|---|
| ✓ Using the Pythagorean Theorem *Understanding slope as a rate of change of one quantity in relation to another quantity<br>✓ Interpreting a graph *Creating a table of values *Working with functions<br>✓ Writing a linear equation *Using inverse operations to isolate variables and solve equations<br>✓ Maintaining order of operations *Understanding notation for inequalities *Graphing points<br>✓ Being able to read and write inequality symbols<br>✓ Graphing equations and inequalities on the coordinate plane<br>✓ Understanding and use properties of exponents *Choosing appropriate scales and label a graph | *20 Days* |

| ***Concept 1***<br>***Creating Equations/Geometric Sequences*** | ***Concept 2***<br>***Graphing & Characteristics*** | ***Concept 3***<br>***Application and Multiple Representations*** |
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| Create equations that describe numbers or relationship Build a function that models a relationship between two quantities. | Build new functions from existing functions, graph and identify characteristics of exponential functions. | Interpret functions that arise in applications in terms of the context. Analyze functions using different representations. |
| ***Concept 1***<br>***GSE Standards*** | ***Concept 2***<br>***GSE Standards*** | ***Concept 3***<br>***GSE Standards*** |
| **MGSE9-12.A.CED.1**<br>Create equations and inequalities in one variable and use them to solve problems. Include equations arising from ~~linear, quadratic, simple rational, and~~ exponential functions (integer inputs only).<br><br>**MGSE9-12.A.CED.2**<br>Create ~~linear, quadratic, and~~ exponential equations in two or more variables to represent relationships between quantities; (The phrase "in two or more variables" refers to formulas like the compound interest formula, in which $A = P(1 + \frac{r}{n})^{nt}$ has multiple variables.) | **MGSE9-12.A.CED.2**<br>Create ~~linear, quadratic, and~~ exponential equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.<br><br>**MGSE9-12.F.BF.3**<br>Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. | **MGSE9-12.F.IF.4**<br>Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; ~~and periodicity~~.<br><br>**MGSE9-12.F.IF.5**<br>Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* |

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| **MGSE9-12.F.BF.1**<br>Write a function that describes a relationship between two quantities.<br><br>**MGSE9-12.F.BF.1a**<br>Determine an explicit expression and the recursive process (steps for calculation) from context.<br>*For example, if Jimmy starts out with $15 and earns $2 a day, the explicit expression "2x+15" can be described recursively (either in writing or verbally) as "to find out how much money Jimmy will have tomorrow, you add $2 to his total today."*<br>$J_n = J_{n-1} + 2, J_0 = 15$<br><br>**MGSE9-12.F.BF.2**<br>Write ~~arithmetic and~~ geometric sequences recursively and . explicitly, use them to model situations, and translate between the two forms. Connect ~~arithmetic sequences to linear functions and~~ geometric sequences to exponential functions.<br><br>**MGSE9-12.F.IF.3**<br>Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. (Generally, the scope of high school math defines this subset as the set of natural numbers 1,2,3,4...) By graphing or calculating terms, students should be able to show how the recursive sequence<br>$a_1 = 7, \ a_n = a_{n-1} + 2$<br>the sequence<br>$s_n = 2(n-1) + 7$<br>and the function f(x) = 2x + 5 (when x is a natural number) all define the same sequence. | **MGSE9-12.F.IF.6**<br>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.<br><br>**MGSE9-12.F.IF.7**<br>Graph functions expressed algebraically and show key features of the graph both by hand and by using technology.<br><br>**MGSE9-12.F.IF.7e**<br>Graph exponential ~~and logarithmic~~ functions, showing intercepts and end behavior, ~~and trigonometric functions, showing period, midline, and amplitude~~.<br><br>**MGSE9-12.F.IF.1**<br>Understand that a function from one set (the input, called the domain) to another set (the output, called the range) assigns to each element of the domain exactly one element of the range, i.e. each input value maps to exactly one output value. If f is a function, x is the input (an element of the domain), and f(x) is the output (an element of the range). Graphically, the graph is y = f(x).<br><br>**MGSE9-12.F.IF.2**<br>Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. | **MGSE9-12.F.IF.9**<br>Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one function and an algebraic expression for another, say which has the larger maximum.* |
| ***Concept 1***<br>***Lesson Essential Question*** | ***Concept 2***<br>***Lesson Essential Question*** | ***Concept 3***<br>***Lesson Essential Question*** |
| How do I create exponential equations and inequalities in one variable?<br>How do I solve exponential equations in one variable?<br>How do I write/build an exponential equation that describes a relationship between two quantities?<br>Why are geometric sequences functions and how do I write and solve them? | How do I graph exponential functions?<br>What are the effects on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative)?<br>What are the characteristics of exponential functions and how do I identify and write them using proper notation?<br>How do I calculate and interpret the average rate of change of a function?<br>Why is the concept of a function important and how do I use function notation to show a variety of situations | How do I use graphs to represent and solve real-world equations?<br>How do I interpret functions that arise in applications in terms of context?<br>How do I use different representations to analyze exponential functions?<br>How can we use real-world situations to construct and compare exponential models and solve problems?<br>How do I interpret expressions for functions in terms of the situation they model? |

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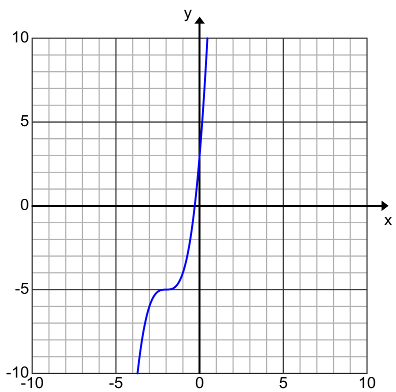
| | modeled by functions?<br>How do I distinguish between even and odd functions from their graphs and algebraic expressions for them? | |
| ***Concept 1 Vocabulary*** | ***Concept 2 Vocabulary*** | ***Concept 3 Vocabulary*** |
| Algebra<br>Coefficient<br>Discrete<br>Equation<br>Explicit Expression<br>Exponential Function<br>Expression<br>Factor<br>Geometric Sequence<br>Irrational Number<br>Natural Numbers<br>Rational Numbers<br>Real Numbers<br>Recursive Formula<br>Term<br>Variable<br>Whole Numbers | Average Rate of Change<br>Continuous<br>Domain<br>End Behaviors<br>Horizontal Translation<br>Interval Notation<br>Ordered Pair<br>Parameter<br>Range<br>Reflection<br>Vertical Translation<br>X-Intercept<br>Y-Intercept<br>Even/Odd Function | Exponential Model<br>Tables |
| ***Concept 1***<br>***Sample Assessment Items*** | ***Concept 2***<br>***Sample Assessment Items*** | ***Concept 3***<br>***Sample Assessment Items*** |
| **MGSE9-12.A.CED.1**<br>You bought a car for $5,000. Each year it appreciates in value by 8.5%. Which equation can be used to find the value, *v*, of the car, *x* years after it was purchased?<br>A $v = 5000(1 \bullet 0.085)^x$ c $v = 0.085(5000)^x$<br>b $v = 5000(1 - 0.085)^x$ d $v = 5000(1 + 0.085)^x$<br><br>**MGSE9-12.A.CED.2**<br><br>**MGSE9-12.F.BF.1**<br><br>**MGSE9-12.F.BF.1a**<br><br>**MGSE9-12.F.BF.2**<br><br>**MGSE9-12.F.IF.3** | **MGSE.9-12.F.BF.3**<br>The graph of g(x) is shown below. The graph of g(x) can be obtained by applying horizontal and vertical shifts to the parent function f(x) = $x^3$ . What is g(x)?<br><br>a. $f(x) = (x - 2)^3 + 5$<br>b. $f(x) = (x + 2)^3 - 5$<br>c. $f(x) = (x - 5)^3 + 2$<br>d. $f(x) = (x + 5)^3 - 2$<br><br>**MGSE.9-12.F.IF.6**<br>**MGSE.9-12.F.IF.7**<br>**MGSE.9-12.F.IF.7e** | **MGSE.9-12.F.IF.4**<br>**MGSE.9-12.F.IF.5**<br>**MGSE.9-12.F.IF.9** |

# GSE Algebra I Unit 4

## At the end of Unit 4 student's should be able to say "I can…"

- ✓ Define and use function notation, evaluate functions at any point in the domain, give general statements about how f(x) behaves at different regions in the domain (as x gets very large or very negative, close to 0 etc.), and interpret statements that use function notation.
- ✓ Explain the difference and relationship between domain and range and find the domain and range of a function from a contextual situation, function equation, table, or graph.
- ✓ Examine data (from a table, graph, or set of points) and determine if the data represent a function and explain any conclusions that can be drawn.
- ✓ Write a function from a sequence or a sequence from a function.
- ✓ Explain how a geometric sequence is related to its algebraic function notation.
- ✓ Interpret x and y intercepts, where the function is increasing or decreasing, where it is positive or negative, its end behaviors, given the graph, table, or algebraic representation of a linear or exponential function in terms of the context of the function.
- ✓ Find and/or interpret appropriate domains and ranges for authentic exponential functions.
- ✓ Calculate and interpret the average rate of change over a given interval of a function from a function equation, graph or table, and explain what that means in terms of the context of the function.
- ✓ Estimate the rate of change of a function from its graph at any point in its domain.
- ✓ Explain the relationship between the domain of a function and its graph in general and/or to the context of the function.
- ✓ Graph an exponential function using technology.
- ✓ Sketch the graph of an exponential function accurately identifying x- and y-intercepts and asymptotes.
- ✓ Describe the end behavior of an exponential function (what happens as x approaches positive or negative infinity).
- ✓ Discuss and compare two different functions represented in different ways (tables, graphs or equations). Discussion and comparisons should include: identifying differences in rates of change, intercepts, and/or where each function is greater or less than the other.
- ✓ Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs.
- ✓ Experiment with cases and illustrate an explanation of the effects on the graph using technology.
- ✓ Write recursive and explicit formulas for geometric sequences.
- ✓ Construct and compare exponential models and solve problems. Recognize situations in which a quantity either grows or decays by a constant percent rate.
- ✓ Recognize even and odd functions from their graphs and algebraic expressions for them.