GSE Algebra I

Unit Three Information

Georgia Milestones Domain & Weight:
Algebra and Functions (includes Number and Quantity) 60%

Curriculum Map: Modeling and Analyzing Quadratic Functions

Content Descriptors:

- Concept 1: Factoring Quadratics
- Concept 2: Solving Quadratics
- Concept 3: Graphing Quadratics
- Concept 4: Characteristics of Quadratics
- Concept 5: Applications of Quadratics

Content from Frameworks: Modeling & Analyzing Quadratic Functions

Unit Length: Approximately 40 days

Georgia Milestones Study Guide for Modeling & Analyzing Quadratic Functions

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Unit Rational:
Students will analyze quadratic functions only. Students will (1) investigate key features of graphs; (2) solve quadratic equations by taking square roots, factoring ($x^2 + bx + c$ AND $ax^2 + bx + c$), completing the square, and using the quadratic formula; (3) compare and contrast graphs in standard, vertex, and intercept forms. Students will only work with real number solutions.

Prerequisites: As identified by the GSE Frameworks

- ✓ Use Function Notation
- ✓ Graph data from tables
- ✓ Solve one variable linear equations
- ✓ Solve for any variable in a multi-variable equation
- ✓ Graph linear functions
- *Put data into tables
- *Distinguish between linear and non-linear functions
- *Determine domain of a problem situation
- *Recognize slope of a linear function as a rate of change
- *Graph inequalities

Length of Unit

40 Days

Concept 1 Factoring	***Concept 2 Solving***	***Concept 3 Graphing***	***Concept 4 Characteristics***	***Concept 5 Application***
Interpret the structure of expressions. Write expressions in equivalent forms to solve problems.	Solve equations and inequalities in one variable .	Analyze functions using Different representations. Build new functions from existing functions. Analyze functions using different representations.	Identify and interpret key features of graphs and tables (quadratic functions).	Create equations that describe numbers or relationships. Interpret functions that arise in applications in terms of the context. Build a function that models a relationship between two quantities . Understand the concept of a function and use function notation.
Concept 1 GSE Standards	***Concept 2 GSE Standards***	***Concept 3 GSE Standards***	***Concept 4 GSE Standards***	***Concept 5 GSE Standards***
MGSE9-12.A.SSE.2 Use the structure of an expression to rewrite it in different equivalent forms. For example, see $x4 – y4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of	**MGSE9-12.A.REI.4** Solve quadratic equations in one variable. **MGSE9–12.A.REI.4a** Use the method of completing the	**MGSE9-12.F.IF.7** Graph functions expressed algebraically and show key features of the graph both by hand and by using technology.	**MGSE9-12.F.IF.4** Using tables, graphs,, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch graphs	**MGSE9-12.A.CED.1** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from ~~linear and~~ quadratic functions, ~~and simple rational~~

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squares that can be factored as $(x^2 – y^2)(x^2 + y^2)$. **MGSE9-12.A.SSE.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. **MGSE9-12.A.SSE.3a** Factor any quadratic expression to reveal the zeros of the function defined by the expression. **MGSE9–12.A.SSE.3b** Complete the square in a quadratic expression to reveal the maximum and minimum value of the function defined by the expression. **MGSE9-12.A.CED.4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. Examples: Rearrange Ohm's law V = IR to highlight resistance R; Rearrange area of a circle formula $A = \pi r^2$ to highlight the radius.	square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from $ax^2 + bx + c = 0$. **MGSE9-12.A.REI.4b** Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, factoring, ~~completing the square~~, and the quadratic formula, as appropriate to the initial form of the equation. (limit to real number solutions).	**MGSE9-12.F.IF.7a** Graph linear and quadratic functions and show intercepts, maxima, and minima ((as determined by the function or by context). **MGSE9-12.A.CED.2** Create quadratic equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (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.F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **MGSE9-12.F.BF.3** 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. *(Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept.)*	showing key features including: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; ~~and periodicity.~~ **MGSE9-12.F.IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. **MGSE9-12.F.IF.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. **MGSE9-12.F.IF.8a** Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. *For example, compare and contrast quadratic functions in standard, vertex, and intercept forms.* **MGSE9-12.F.IF.9** 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.*	~~and exponential functions~~. **MGSE9-12.F.BF.1** Write a function that describes a relationship between two quantities. **MGSE9–12.F.IF.1** 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). **MGSE9–12.F.IF.2** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

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Concept 1 ***Lesson Essential Question***	***Concept 2*** ***Lesson Essential Question***	***Concept 3*** ***Lesson Essential Question***	***Concept 4*** ***Lesson Essential Question***	***Concept 5*** ***Lesson Essential Question***
How is a relation determined to be quadratic? Are all quadratic expressions factorable? How do you factor a quadratic expression? What are two equivalent forms of a Quadratic expression?	How do you solve a quadratic equation?	What information can be gathered from the table of values and the graph of a relation? How do you graph a quadratic function? How can the graph of $f(x) = x^2$ move left, right, up, down, stretch, or compress?	Where is the maximum or minimum value of a quadratic equation located? What does the domain of a function tell about the quantitative relationship of the given data? What are and how do you find the important parts of a quadratic function? What is the difference between a quadratic equation and a quadratic inequality?	How do you create and solve quadratic equations and inequalities from context? How is the rate of change for a quadratic function different from the rate of change for a linear function? How do you evaluate functions interpret the solution in context?
Concept 1 Vocabulary	***Concept 2 Vocabulary***	***Concept 3 Vocabulary***	***Concept 4 Vocabulary***	***Concept 5 Vocabulary***
Quadratic Expression Quadratic Equation Quadratic Function Standard Form Vertex Form Standard Form Difference of squares Perfect Square Trinomial Factors Factorization Binomial	Solution x-intercept roots zeros Square Root Method Quadratic Formula Discriminant	Horizontal Shift Vertical Shift Stretch Shrink (compress) Reflection Parabola Axis of Symmetry Vertex	Domain Range y-intercept Extrema Maximum Minimum End behaviors Increasing Decreasing Inequality	Rate of Change Linear Function Notation Input Output
Concept 1 ***Sample Assessment Items***	***Concept 2*** ***Sample Assessment Items***	***Concept 3*** ***Sample Assessment Items***	***Concept 4*** ***Sample Assessment Items***	***Concept 5*** ***Sample Assessment Items***

At the end of Unit 3 student's should be able to say "I can…"

- ✓ focus on quadratic functions, equations, and applications
- ✓ explore variable rate of change
- ✓ learn to factor general quadratic expressions completely over the integers and to solve general quadratic equations by factoring by working with quadratic functions that model the behavior of objects that are thrown in the air and allowed to fall subject to the force of gravity
- ✓ learn to find the vertex of the graph of any polynomial function and to convert the formula for a quadratic function from standard to vertex form
- ✓ apply the vertex form of a quadratic function to find real solutions of quadratic equations that cannot be solved by factoring
- ✓ explore only real solutions to quadratic equations
- ✓ explain why the graph of every quadratic function is a translation of the graph of the basic function f (x) =x2
- ✓ apply the quadratic formula
- ✓ justify the quadratic formula