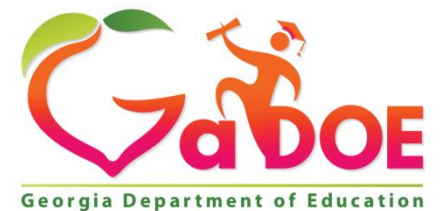


# Georgia Standards of Excellence Curriculum Map



## Mathematics

GSE Coordinate Algebra



Richard Woods, Georgia's School Superintendent  
"Educating Georgia's Future"

Georgia Department of Education

GSE Coordinate Algebra Curriculum Map

1 <sup>st</sup> Semester			2 <sup>nd</sup> Semester		
Unit 1 (4 – 5 weeks)	Unit 2 (4 – 5 weeks)	Unit 3 (6 – 7 weeks)	Unit 4 (5 – 6 weeks)	Unit 5 (4 – 5 weeks)	Unit 6 (4 – 5 weeks)
Relationships Between Quantities	Reasoning with Equations and Inequalities	Linear and Exponential Functions	Describing Data	Transformations in the Coordinate Plane	Connecting Algebra and Geometry Through Coordinates
MGSE9-12.N.Q.1 MGSE9-12.N.Q.2 MGSE9-12.N.Q.3 MGSE9-12.A.SSE.1 MGSE9-12.A.SSE.1a MGSE9-12.A.SSE.1b MGSE9-12.A.CED.1 MGSE9-12.A.CED.2 MGSE9-12.A.CED.3 MGSE9-12.A.CED.4	MGSE9-12.A.REI.1 MGSE9-12.A.REI.3 MGSE9-12.A.REI.5 MGSE9-12.A.REI.6 MGSE9-12.A.REI.12	MGSE9-12.A.REI.10 MGSE9-12.A.REI.11 MGSE9-12.F.IF.1 MGSE9-12.F.IF.2 MGSE9-12.F.IF.3 MGSE9-12.F.IF.4 MGSE9-12.F.IF.5 MGSE9-12.F.IF.6 MGSE9-12.F.IF.7 MGSE9-12.F.IF.7a MGSE9-12.F.IF.e MGSE9-12.F.IF.9 MGSE9-12.F.BF.1 MGSE9-12.F.BF.1a MGSE9-12.F.BF.2 MGSE9-12.F.BF.3 MGSE9-12.F.LE.1 MGSE9-12.F.LE.1a MGSE9-12.F.LE.1b MGSE9-12.F.LE.1c MGSE9-12.F.LE.2 MGSE9-12.F.LE.3 MGSE9-12.F.LE.5	MGSE9-12.S.ID.1 MGSE9-12.S.ID.2 MGSE9-12.S.ID.3 MGSE9-12.S.ID.5 MGSE9-12.S.ID.6 MGSE9-12.S.ID.6a MGSE9-12.S.ID.6c MGSE9-12.S.ID.7 MGSE9-12.S.ID.8 MGSE9-12.S.ID.9	MGSE9-12.G.CO.1 MGSE9-12.G.CO.2 MGSE9-12.G.CO.3 MGSE9-12.G.CO.4 MGSE9-12.G.CO.5	MGSE9-12.G.GPE.4 MGSE9-12.G.GPE.5 MGSE9-12.G.GPE.6 MGSE9-12.G.GPE.7
These units were written to build upon concepts from prior units, so later units contain tasks that depend upon the concepts addressed in earlier units. All units will include the Mathematical Practices and indicate skills to maintain.					

**NOTE:** Mathematical standards are interwoven and should be addressed throughout the year in as many different units and tasks as possible in order to stress the natural connections that exist among mathematical topics.

**Grade 9-12 Key:**

**Number and Quantity Strand:** RN = The Real Number System, Q = Quantities, CN = Complex Number System, VM = Vector and Matrix Quantities

**Algebra Strand:** SSE = Seeing Structure in Expressions, APR = Arithmetic with Polynomial and Rational Expressions, CED = Creating Equations, REI = Reasoning with Equations and Inequalities

**Functions Strand:** IF = Interpreting Functions, LE = Linear and Exponential Models, BF = Building Functions, TF = Trigonometric Functions

**Geometry Strand:** CO = Congruence, SRT = Similarity, Right Triangles, and Trigonometry, C = Circles, GPE = Expressing Geometric Properties with Equations, GMD = Geometric Measurement and Dimension,

MG = Modeling with Geometry

**Statistics and Probability Strand:** ID = Interpreting Categorical and Quantitative Data, IC = Making Inferences and Justifying Conclusions, CP = Conditional Probability and the Rules of Probability, MD = Using Probability to Make Decisions

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### Georgia Standards of Excellence Coordinate Algebra Curriculum Map Rationale

**Unit 1:** Building on standards from middle school, students will use quantities to model and analyze situations, use quantities to interpret expressions, and use quantities to create equations and inequalities to describe situations. In solving real-world problems, students will use equations or inequalities, along with systems of equations and/or inequalities, to create, represent, and interpret constraints that may limit solutions. Students will rearrange formulas to highlight a quantity of interest.

**Unit 2:** Building on standards from middle school, students will analyze and explain the process of solving a linear equation, solve linear equations and inequalities in one variable, analyze and explain the process of solving a system of linear equations in two variables, solve a system of linear equations in two variables, and graph the solution set to a linear inequality in two variables.

**Unit 3:** Students will analyze, compare, and contrast linear and exponential functions. Students will investigate key features of graphs, and create, solve, and graphically model linear and exponential functions. Students will recognize arithmetic sequences as linear functions and recognize geometric functions as exponential functions. Students will distinguish between real-world situations that can modeled with linear functions and with exponential functions.

**Unit 4:** Students will summarize, represent, and interpret data on a single count or measurement variable. Students will summarize, represent, and interpret data on two categorical and quantitative variables. Students will interpret linear models.

**Unit 5:** Building on standards from middle school, students will perform transformations in the coordinate plane, describe a sequence of transformations that will map one figure onto another, and describe transformations that will map a figure onto itself. Students will compare transformations that preserve distance and angle to those that do not.

**Unit 6:** Students will use the concepts of distance, midpoint, and slope to verify algebraically geometric relationships of figures in the coordinate plane (triangles and quadrilaterals). Students will solve problems involving parallel and perpendicular lines, perimeters and areas of polygons, and the partitioning of a segment in a given ratio.

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### GSE Coordinate Algebra Expanded Curriculum Map – 1<sup>st</sup> Semester

#### Standards for Mathematical Practice

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|--|--|
| <p>1 Make sense of problems and persevere in solving them.</p> <p>2 Reason abstractly and quantitatively.</p> <p>3 Construct viable arguments and critique the reasoning of others.</p> <p>4 Model with mathematics.</p> | <p>5 Use appropriate tools strategically.</p> <p>6 Attend to precision.</p> <p>7 Look for and make use of structure.</p> <p>8 Look for and express regularity in repeated reasoning.</p> |
|--|--|

#### 1<sup>st</sup> Semester

Unit 1	Unit 2	Unit 3
<b>Relationships Between Quantities</b>	<b>Reasoning with Equations and Inequalities</b>	<b>Linear and Exponential Functions</b>
<p><b><u>Reason quantitatively and use units to solve problems</u></b>  <b>MGSE9-12.N.Q.1</b> Use units of measure (linear, area, capacity, rates, and time) as a way to understand problems:</p> <ol style="list-style-type: none"> <li>Identify, use, and record appropriate units of measure within context, within data displays, and on graphs;</li> <li>Convert units and rates using dimensional analysis (English-to-English and Metric-to-Metric without conversion factor provided and between English and Metric with conversion factor);</li> <li>Use units within multi-step problems and formulas; interpret units of input and resulting units of output.</li> </ol> <p><b>MGSE9-12.N.Q.2</b> Define appropriate quantities for the purpose of descriptive modeling. Given a situation, context, or problem, students will determine, identify, and use appropriate quantities for representing the situation.</p> <p><b>MGSE9-12.N.Q.3</b> Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. <i>For example, money situations are generally reported to the nearest cent (hundredth). Also, an answers' precision is limited to the precision of the data given.</i></p> <p><b><u>Interpret the structure of expressions</u></b>  <b>MGSE9-12.A.SSE.1</b> Interpret expressions that represent a quantity in terms of its context.  <b>MGSE9-12.A.SSE.1a</b> Interpret parts of an expression, such as terms, factors, and coefficients.  <b>MGSE9-12.A.SSE.1b</b> Given situations which utilize formulas or expressions with multiple terms and/or factors, interpret the meaning (in context) of individual terms or factors.</p> <p><b><u>Create equations that describe numbers or relationships</u></b>  <b>MGSE9-12.A.CED.1</b> Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions (integer inputs only).  <b>MGSE9-12.A.CED.2</b> Create linear and exponential 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 <math>A = P(1</math></p>	<p><b><u>Understand solving equations as a process of reasoning and explain the reasoning</u></b>  <b>MGSE9-12.A.REI.1</b> Using algebraic properties and the properties of real numbers, justify the steps of a simple, one-solution equation. Students should justify their own steps, or if given two or more steps of an equation, explain the progression from one step to the next using properties.</p> <p><b><u>Solve equations and inequalities in one variable</u></b>  <b>MGSE9-12.A.REI.3</b> Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. <i>For example, given <math>ax + 3 = 7</math>, solve for <math>x</math>.</i></p> <p><b><u>Solve systems of equations</u></b>  <b>MGSE9-12.A.REI.5</b> Show and explain why the elimination method works to solve a system of two-variable equations.  <b>MGSE9-12.A.REI.6</b> Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.</p> <p><b><u>Represent and solve equations and inequalities graphically</u></b>  <b>MGSE9-12.A.REI.12</b> Graph the solution set to a linear inequality in two variables.</p>	<p><b><u>Represent and solve equations and inequalities graphically</u></b>  <b>MGSE9-12.A.REI.10</b> Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.  <b>MGSE9-12.A.REI.11</b> Using graphs, tables, or successive approximations, show that the solution to the equation <math>f(x) = g(x)</math> is the <math>x</math>-value where the <math>y</math>-values of <math>f(x)</math> and <math>g(x)</math> are the same.</p> <p><b><u>Understand the concept of a function and use function notation</u></b>  <b>MGSE9-12.F.IF.1</b> 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 <math>f</math> is a function, <math>x</math> is the input (an element of its domain), and <math>f(x)</math> is the output (an element of the range). Graphically, the graph is <math>y = f(x)</math>.  <b>MGSE9-12.F.IF.2</b> Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.  <b>MGSE9-12.F.IF.3</b> 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 <math>a_1 = 7, a_n = a_{n-1} + 2</math>; the sequence <math>s_n = 2(n - 1) + 7</math>; and the function <math>f(x) = 2x + 5</math> (when <math>x</math> is a natural number) all define the same sequence.</p> <p><b><u>Interpret functions that arise in applications in terms of the context</u></b>  <b>MGSE9-12.F.IF.4</b> 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; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.  <b>MGSE9-12.F.IF.5</b> Relate the domain of a function to its graph</p>

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+  $r/n)^m$  has multiple variables.)

**MGSE9-12.A.CED.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret data points as possible (i.e. a solution) or not possible (i.e. a non-solution) under the established constraints.

**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  $r$ .*

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.*

**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.

**Analyze functions using different representations**

**MGSE9-12.F.IF.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology.

**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.F.IF.7e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

**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.*

**Build a function that models a relationship between two quantities**

**MGSE9-12.F.BF.1** Write a function that describes a relationship between two quantities.

**MGSE9-12.F.BF.1a** Determine an explicit expression and the recursive process (steps for calculation) from context. *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."*

$$J_n = J_{n-1} + 2, J_0 = 15.$$

**MGSE9-12.F.BF.2** 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.

**Build new functions from existing functions**

**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.~~

**Construct and compare linear, quadratic, and exponential models and solve problems**

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		<p><b>MGSE9-12.F.LE.1</b> Distinguish between situations that can be modeled with linear functions and with exponential functions.</p> <p><b>MGSE9-12.F.LE.1a</b> Show that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. (This can be shown by algebraic proof, with a table showing differences, or by calculating average rates of change over equal intervals).</p> <p><b>MGSE9-12.F.LE.1b</b> Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p> <p><b>MGSE9-12.F.LE.1c</b> Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.</p> <p><b>MGSE9-12.F.LE.2</b> 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).</p> <p><b>MGSE9-12.F.LE.3</b> Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, <del>quadratically, or (more generally) as a polynomial function.</del></p> <p><b><u>Interpret expressions for functions in terms of the situation they model</u></b></p> <p><b>MGSE9-12.F.LE.5</b> Interpret the parameters in a linear (<math>f(x) = mx + b</math>) and exponential (<math>f(x) = a \cdot d^x</math>) function in terms of a context. (In the functions above, “m” and “b” are the parameters of the linear function, and “a” and “d” are the parameters of the exponential function.) In context, students should describe what these parameters mean in terms of change and starting value.</p>
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GSE Coordinate Algebra Expanded Curriculum Map – 2<sup>nd</sup> Semester

Standards for Mathematical Practice

- 1 Make sense of problems and persevere in solving them.
- 2 Reason abstractly and quantitatively.
- 3 Construct viable arguments and critique the reasoning of others.
- 4 Model with mathematics.

- 5 Use appropriate tools strategically.
- 6 Attend to precision.
- 7 Look for and make use of structure.
- 8 Look for and express regularity in repeated reasoning.

2<sup>nd</sup> Semester

Unit 4	Unit 5	Unit 6
<p align="center"><b>Describing Data</b></p>	<p align="center"><b>Transformations in the Coordinate Plane</b></p>	<p align="center"><b>Connecting Algebra and Geometry Through Coordinates</b></p>
<p><b><u>Summarize, represent, and interpret data on a single count or measurement variable</u></b>  <b>MGSE9-12.S.ID.1</b> Represent data with plots on the real number line (dot plots, histograms, and box plots).  <b>MGSE9-12.S.ID.2</b> Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, mean absolute deviation, <del>standard deviation</del>) of two or more different data sets.  <b>MGSE9-12.S.ID.3</b> Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).  <b><u>Summarize, represent, and interpret data on two categorical and quantitative variables</u></b>  <b>MGSE9-12.S.ID.5</b> Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.  <b>MGSE9-12.S.ID.6</b> Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.  <b>MGSE9-12.S.ID.6a</b> Decide which type of function is most appropriate by observing graphed data, charted data, or by analysis of context to generate a viable (rough) function of best fit. Use this function to solve problems in context. Emphasize linear, <del>quadratic</del>, and exponential models.  <b>MGSE9-12.S.ID.6c</b> Using given or collected bivariate data, fit a linear function for a scatter plot that suggests a linear association.  <b><u>Interpret linear models</u></b>  <b>MGSE9-12.S.ID.7</b> Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.  <b>MGSE9-12.S.ID.8</b> Compute (using technology) and interpret the correlation coefficient “r” of a linear fit. (For instance, by looking at a scatterplot, students should be able to tell if the correlation coefficient is positive or negative and give a</p>	<p><b><u>Experiment with transformations in the plane</u></b>  <b>MGSE9-12.G.CO.1</b> Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.  <b>MGSE9-12.G.CO.2</b> Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).  <b>MGSE9-12.G.CO.3</b> Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.  <b>MGSE9-12.G.CO.4</b> Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.  <b>MGSE9-12.G.CO.5</b> Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.</p>	<p><b><u>Use coordinates to prove simple geometric theorems algebraically</u></b>  <b>MGSE9-12.G.GPE.4</b> Use coordinates to prove simple geometric theorems algebraically. <i>For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; <del>prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0,2).</del></i>          (Focus on quadrilaterals, right triangles, <del>and circles.</del>)  <b>MGSE9-12.G.GPE.5</b> Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).  <b>MGSE9-12.G.GPE.6</b> Find the point on a directed line segment between two given points that partitions the segment in a given ratio.  <b>MGSE9-12.G.GPE.7</b> Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.</p>

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<p>reasonable estimate of the “r” value.) After calculating the line of best fit using technology, students should be able to describe how strong the goodness of fit of the regression is, using “r.”</p> <p><b>MGSE9-12.S.ID.9</b> Distinguish between correlation and causation.</p>		