Georgia Mathematics

# Enhanced Algebra: Concepts & Connections (for Grade 8)

**Mathematical Practices**

**0 Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals.** A.MP

- 0.1 Make sense of problems and persevere in solving them. A.MP.1
- 0.2 Reason abstractly and quantitatively. A.MP.2
- 0.3 Construct viable arguments and critique the reasoning of others. A.MP.3
- 0.4 Model with mathematics. A.MP.4
- 0.5 Use appropriate tools strategically. A.MP.5
- 0.6 Attend to precision. A.MP.6
- 0.7 Look for and make use of structure. A.MP.7
- 0.8 Look for and express regularity in repeated reasoning. A.MP.8

**Mathematical Modeling**

**1 Apply mathematics to real-life situations; model real-life phenomena using mathematics.** A.MM.1

- 1.1 Explain applicable, mathematical problems using a mathematical model. A.MM.1.1
- 1.2 Create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities domains. A.MM.1.2
- 1.3 Use units of measure (linear, area, capacity, rates, and time) as a way to make sense of conceptual problems; identify, use, and record appropriate units of measure within the given framework, within data displays, and on graphs; convert units and rates using proportional reasoning given a conversion factor; use units within multi-step problems and formulas; interpret units of input and resulting units of output. A.MM.1.3
- 1.4 Use various mathematical representations and structures with this information to represent and solve real-life problems. A.MM.1.4
- 1.5 Define appropriate quantities for the purpose of descriptive modeling. A.MM.1.5

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**olve problems involving irrational numbers and rational approximations of rrational numbers to explain realistic applications.** 8.NR.1

1.1 Distinguish between rational and irrational numbers using decimal expansion. Convert a decimal expansion which repeats eventually into a rational number. 8.NR.1.1

1.2 Approximate irrational numbers to compare the size of irrational numbers, locate them approximately on a number line, and estimate the value of expressions. 8.NR.1.2

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**2 Solve problems involving radicals and integer exponents including relevant application situations; apply place value understanding with scientific notation and use scientific notation to explain real phenomena.** 8.NR.2

2.1 Apply the properties of integer exponents to generate equivalent numerical expressions. 8.NR.2.1

2.2 Use square root and cube root symbols to represent solutions to equations. Recognize that x^ 2 = p (where p is a positive rational number and |x| ≤ 25) has two solutions and x^3 = p (where p is a negative or positive rational number and |x| ≤ 10) has one solution. Evaluate square roots of perfect squares ≤ 625 and cube roots of perfect cubes ≥ -1000 and ≤ 1000. 8.NR.2.2

2.3 Use numbers expressed in scientific notation to estimate very large or very small quantities, and to express how many times as much one is than the other. 8.NR.2.3

2.4 Add, subtract, multiply and divide numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Interpret scientific notation that has been generated by technology (e.g., calculators or online technology tools). 8.NR.2.4

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**5 Investigate rational and irrational numbers and rewrite expressions involving square roots and cube roots.** A.NR.5

5.1 Rewrite algebraic and numeric expressions involving radicals. A.NR.5.1

5.2 Using numerical reasoning, show and explain that the sum or product of rational numbers is rational, the sum of a rational number and an irrational number is irrational, and the product of a nonzero rational number and an irrational number is irrational. A.NR.5.2

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**Patterning & Algebraic Reasoning**

**3 Create and interpret expressions within relevant situations. Create, interpret, and solve linear equations and linear inequalities in one variable to model and explain real phenomena.** 8.PAR.3

3.1 Interpret expressions and parts of an expression, in context, by utilizing formulas or expressions with multiple terms and/or factors. 8.PAR.3.1

3.2 Describe and solve linear equations in one variable with one solution (x = a), infinitely many solutions (a = a), or no solutions (a = b). Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers). 8.PAR.3.2

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3.3 Create and solve linear equations and inequalities in one variable within a relevant application. 8.PAR.3.3

3.4 Using algebraic properties and the properties of real numbers, justify the steps of a one-solution equation or inequality. 8.PAR.3.4

3.5 Solve linear equations and inequalities in one variable with coefficients represented by letters and explain the solution based on the contextual, mathematical situation. 8.PAR.3.5

3.6 Use algebraic reasoning to fluently manipulate linear and literal equations expressed in various forms to solve relevant, mathematical problems. 8.PAR.3.6

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**4 Show and explain the connections between proportional and non-proportional relationships, lines, and linear equations; create and interpret graphical mathematical models and use the graphical, mathematical model to explain real phenomena represented in the graph.** 8.PAR.4

4.1 Use the equation y = mx (proportional) for a line through the origin to derive the equation y = mx + b (non-proportional) for a line intersecting the vertical axis at b. 8.PAR.4.1

4.2 Show and explain that the graph of an equation representing an applicable situation in two variables is the set of all its solutions plotted in the coordinate plane. 8.PAR.4.2

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**4 Create, analyze, and solve linear inequalities in two variables and systems of linear inequalities to model real-life phenomena.** A.PAR.4

4.1 Create and solve linear inequalities in two variables to represent relationships between quantities including mathematically applicable situations; graph inequalities on coordinate axes with labels and scales. A.PAR.4.1

4.2 Represent constraints of linear inequalities and interpret data points as possible or not possible. A.PAR.4.2

4.3 Solve systems of linear inequalities by graphing, including systems representing a mathematically applicable situation. A.PAR.4.3

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**6 Build quadratic expressions and equations to represent and model real-life phenomena; solve quadratic equations in mathematically applicable situations.** A.PAR.6

6.1 Interpret quadratic expressions and parts of a quadratic expression that represent a quantity in terms of its context. A.PAR.6.1

6.2 Fluently choose and produce an equivalent form of a quadratic expression to reveal and explain properties of the quantity represented by the expression. A.PAR.6.2

6.3 Create and solve quadratic equations in one variable and explain the solution in the framework of applicable phenomena. A.PAR.6.3

6.4 Represent constraints by quadratic equations and interpret data points as possible or not possible in a modeling framework. A.PAR.6.4

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8 **Create and analyze exponential expressions and equations to represent and model real-life phenomena; solve exponential equations in mathematically applicable situations.** A.PAR.8

8.1 Interpret exponential expressions and parts of an exponential expression that represent a quantity in terms of its framework. A.PAR.8.1

8.2 Create exponential equations in one variable and use them to solve problems, including mathematically applicable situations. A.PAR.8.2

8.3 Create exponential equations in two variables to represent relationships between quantities, including in mathematically applicable situations; graph equations on coordinate axes with labels and scales. A.PAR.8.3

8.4 Represent constraints by exponential equations and interpret data points as possible or not possible in a modeling environment. A.PAR.8.4

**Functional & Graphical Reasoning**

5 **Describe the properties of functions to define, evaluate, and compare relationships, and use functions and graphs of functions to model and explain real phenomena.** 8.FGR.5

5.1 Show and explain that a function is a rule that assigns to each input exactly one output. 8.FGR.5.1

5.2 Within realistic situations, identify and describe examples of functions that are linear or nonlinear. Sketch a graph that exhibits the qualitative features of a function that has been described verbally. 8.FGR.5.2

5.3 Relate the domain of a linear function to its graph and where applicable to the quantitative relationship it describes. 8.FGR.5.3

5.4 Compare properties (rate of change and initial value) of two functions used to model an authentic situation each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). 8.FGR.5.4

5.5 Write and explain the equations y = mx + b (slope-intercept form), Ax + By = C (standard form), and (y − y1) = m(x − x1) (point-slope form) as defining a linear function whose graph is a straight line to reveal and explain different properties of the function. 8.FGR.5.5

5.6 Write a linear function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. 8.FGR.5.6

5.7 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. 8.FGR.5.7

5.8 Explain the meaning of the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. 8.FGR.5.8

5.9 Graph and analyze linear functions expressed in various algebraic forms and show key characteristics of the graph to describe applicable situations. 8.FGR.5.9

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**6 Solve practical, linear problems involving situations using bivariate quantitative data.** 8.FGR.6

6.1 Show that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, visually fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line of best fit. 8.FGR.6.1

6.2 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercepts. 8.FGR.6.2

6.3 Explain the meaning of the predicted slope (rate of change) and the predicted intercept (constant term) of a linear model in the context of the data. 8.FGR.6.3

6.4 Use appropriate graphical displays from data distributions involving lines of best fit to draw informal inferences and answer the statistical investigative question posed in an unbiased statistical study. 8.FGR.6.4

**7 Justify and use various strategies to solve systems of linear equations to model and explain realistic phenomena.** 8.FGR.7

7.1 Interpret and solve relevant mathematical problems leading to two linear equations in two variables. 8.FGR.7.1

7.2 Show and explain that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because the points of intersection satisfy both equations simultaneously. 8.FGR.7.2

7.4 Analyze and solve systems of two linear equations in two variables algebraically to find exact solutions. 8.FGR.7.4

7.5 Create and compare the equations of two lines that are either parallel to each other, perpendicular to each other, or neither parallel nor perpendicular. 8.FGR.7.5

**2 Construct and interpret arithmetic sequences as functions, algebraically and graphically, to model and explain real-life phenomena. Use formal notation to represent linear functions and the key characteristics of graphs of linear functions, and informally compare linear and non-linear functions using parent graphs.** A.FGR.2

2.1 Use mathematically applicable situations algebraically and graphically to build and interpret arithmetic sequences as functions whose domain is a subset of the integers. A.FGR.2.1

2.2 Construct and interpret the graph of a linear function that models real-life phenomena and represent key characteristics of the graph using formal notation. A.FGR.2.2

2.3 Relate the domain and range of a linear function to its graph and, where applicable, to the quantitative relationship it describes. Use formal interval and set notation to describe the domain and range of linear functions. A.FGR.2.3

.4 Use function notation to build and evaluate linear functions for inputs in their domains and interpret statements that use function notation in terms of a mathematical framework. A.FGR.2.4

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2.5 Analyze the difference between linear functions and nonlinear functions by informally analyzing the graphs of various parent functions (linear, quadratic, exponential, absolute value, square root, and cube root parent curves). A.FGR.2.5

**7 Construct and interpret quadratic functions from data points to model and explain real-life phenomena; describe key characteristics of the graph of a quadratic function to explain a mathematically applicable situation for which the graph serves as a model.** A.FGR.7

7.1 Use function notation to build and evaluate quadratic functions for inputs in their domains and interpret statements that use function notation in terms of a given framework. A.FGR.7.1

7.2 Identify the effect on the graph generated by a quadratic function when replacing f(x) with f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. A.FGR.7.2

7.3 Graph and analyze the key characteristics of quadratic functions. A.FGR.7.3

7.4 Relate the domain and range of a quadratic function to its graph and, where applicable, to the quantitative relationship it describes. A.FGR.7.4

7.5 Rewrite a quadratic function representing a mathematically applicable situation to reveal the maximum or minimum value of the function it defines. Explain what the value describes in context. A.FGR.7.5

7.6 Create quadratic functions in two variables to represent relationships between quantities; graph quadratic functions on the coordinate axes with labels and scales. A.FGR.7.6

7.7 Estimate, calculate, and interpret the average rate of change of a quadratic function and make comparisons to the average rate of change of linear functions. A.FGR.7.7

7.8 Write a function defined by a quadratic expression in different but equivalent forms to reveal and explain different properties of the function. A.FGR.7.8

7.9 Compare characteristics of two functions each represented in a different way. A.FGR.7.9

**9 Construct and analyze the graph of an exponential function to explain a mathematically applicable situation for which the graph serves as a model; compare exponential with linear and quadratic functions.** A.FGR.9

9.1 Use function notation to build and evaluate exponential functions for inputs in their domains and interpret statements that use function notation in terms of a context. A.FGR.9.1

9.2 Graph and analyze the key characteristics of simple exponential functions based on mathematically applicable situations. A.FGR.9.2

9.3 Identify the effect on the graph generated by an exponential function when replacing f(x) with f(x) + k, and kf(x), for specific values of k (both positive and negative); find the value of k given the graphs. A.FGR.9.3

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9.4 Use mathematically applicable situations algebraically and graphically to build and interpret geometric sequences as functions whose domain is a subset of the integers. A.FGR.9.4

9.5 Compare characteristics of two functions each represented in a different way. A.FGR.9.5

**Geometric & Spatial Reasoning**

**8 Solve contextual, geometric problems involving the Pythagorean Theorem and the volume of geometric figures to explain real phenomena.** 8.GSR.8

8.1 Explain a proof of the Pythagorean Theorem and its converse using visual models. 8.GSR.8.1

8.2 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles within authentic, mathematical problems in two and three dimensions. 8.GSR.8.2

8.3 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system in practical, mathematical problems. 8.GSR.8.3

8.4 Apply the formulas for the volume of cones, cylinders, and spheres and use them to solve in relevant problems. 8.GSR.8.4

**3 Solve problems involving distance, midpoint, slope, area, and perimeter to model and explain real-life phenomena** A.GSR.3

3.1 Solve real-life problems involving slope, parallel lines, perpendicular lines, area, and perimeter. A.GSR.3.1

3.2 Apply the distance formula, midpoint formula, and slope of line segments to solve real-world problems. A.GSR.3.2

**Data & Statistical Reasoning**

**10 Collect, analyze, and interpret univariate quantitative data to answer statistical investigative questions that compare groups to solve real-life problems; Represent bivariate data on a scatter plot and fit a function to the data to answer statistical questions and solve real-life problems.** A.DSR.10

10.1 Use statistics appropriate to the shape of the data distribution to compare and represent center (median and mean) and variability (interquartile range, standard deviation) of two or more distributions by hand and using technology. A.DSR.10.1

10.2 Interpret differences in shape, center, and variability of the distributions based on the investigation, accounting for possible effects of extreme data points (outliers). A.DSR.10.2

10.3 Represent data on two quantitative variables on a scatter plot and describe how the variables are related. A.DSR.10.3

10.4 Interpret the slope (predicted rate of change) and the intercept (constant term) of a linear model based on the investigation of the data. A.DSR.10.4

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10.5 Calculate the line of best fit and interpret the correlation coefficient, r, of a linear fit using technology. Use r to describe the strength of the goodness of fit of the regression. Use the linear function to make predictions and assess how reasonable the prediction is in context. A.DSR.10.5

10.6 Decide which type of function is most appropriate by observing graphed data. A.DSR.10.6

10.7 Distinguish between correlation and causation. A.DSR.10.7