



Maths - USA

ALGEBRA 1



Experience Level: **HIGH SCHOOL**



Number of Classes: **VARIABLE**



Age Range: **13 - 18 YEARS**

01

Number and Quantity

- The Real Number System
- Extend the properties of exponents to rational exponents.
 - Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
- Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- Use properties of rational and irrational numbers.
- Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational



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01

Number and Quantity (Contd.)

- Quantities
- Reason quantitatively and use units to solve problems.
- Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas.
- Define appropriate quantities for the purpose of descriptive modeling.
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

02

Algebra

- Seeing Structure in Expressions
- Interpret the structure of expressions
 - Interpret expressions that represent a quantity in terms of its context.
 - Interpret parts of an expression, such as terms, factors, and coefficients.
 - Interpret complicated expressions by viewing one or more of their parts as a single entity.
- Use the structure of an expression to identify ways to rewrite it.
- Write expressions in equivalent forms to solve problems
 - Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
 - Factor a quadratic expression to reveal the zeros of the function it defines.



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Algebra (Contd.)

- Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
- Use the properties of exponents to transform expressions for exponential functions.
- Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.
- Arithmetic with Polynomials and Rational Expressions
 - Perform arithmetic operations on polynomials
 - Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- Creating Equations
 - Create equations that describe numbers or relationships
 - Create equations and inequalities in one variable and use them to solve problems.
 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
 - Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.



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Algebra (Contd.)

- Reasoning with Equations and Inequalities
- Understand solving equations as a process of reasoning and explain the reasoning
 - Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution.
- Solve equations and inequalities in one variable
 - Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
 - Solve quadratic equations in one variable.
 - Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions.
 - Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.
- Solve systems of equations
 - Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
 - Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.



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Algebra (Contd.)

- Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.
- Represent a system of linear equations as a single matrix equation in a vector variable.
- Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3×3 or greater).
- Represent and solve equations and inequalities graphically
 - Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve
 - Explain why the x -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$.
 - Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

03

Functions

- Interpreting Functions
- Understand the concept of a function and use function notation
 - Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.



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Functions (Contd.)

- Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- Interpret functions that arise in applications in terms of the context
 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
 - Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
 - Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.
- Analyze functions using different representations
 - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
 - Graph linear and quadratic functions and show intercepts, maxima, and minima.
 - Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
 - Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.



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Functions (Contd.)

- Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
 - 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.
 - Use the properties of exponents to interpret expressions for exponential functions.
- Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
- Building Functions
 - Build a function that models a relationship between two quantities
 - Write a function that describes a relationship between two quantities.
 - Determine an explicit expression, a recursive process, or steps for calculation from a context.
 - Combine standard function types using arithmetic operations.
 - Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
 - Build new functions from existing functions
 - 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 inverse functions.



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Functions (Contd.)

- Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse.
- Linear, Quadratic, and Exponential Models
 - Construct and compare linear, quadratic, and exponential models and solve problems
 - Distinguish between situations that can be modeled with linear functions and with exponential functions.
 - Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
 - Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
 - Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs
- Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- Interpret expressions for functions in terms of the situation they model
 - Interpret the parameters in a linear or exponential function in terms of a context.

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Statistics and Probability

- Interpreting Categorical and Quantitative Data
- Summarize, represent, and interpret data on a single count or measurement variable
 - Represent data with plots on the real number line (dot plots, histograms, and box plots).
- Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- Summarize, represent, and interpret data on two categorical and quantitative variables
 - 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).
 - Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
 - Fit a function to the data; use functions fitted to data to solve problems in the context of the data.
 - Informally assess the fit of a function by plotting and analyzing residuals.
 - Fit a linear function to a scatter plot that suggests a linear association.
- Interpret linear models
 - Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

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Statistics and Probability

- Compute (using technology) and interpret the correlation coefficient of a linear fit.
- Distinguish between correlation and causation.

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