



Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Mathematics
Course: Algebra 1 CPA (H225)
Grade(s): 9-10

Course Overview

This course offers a deep exploration of the advanced topics of Algebra 1. It has been designed to offer a rigorous and comprehensive foundation that addresses the newly expanded core content standards for Algebra 1. It will also provide students the opportunity to truly master algebraic and mathematics skills that will lead to greater achievement in subsequent courses. Throughout this course students will represent linear functions numerically, algebraically, graphically and verbally and work with and interpret these representations. Students will deepen their understanding of relations and functions and expand their repertoire in working with them. Students will develop insight and understanding of the algebraic properties that govern the manipulation of symbols in expressions, equations, and inequalities. Linear, quadratic, exponential and radical functions will be used as mathematical modeling tools providing students with a versatile and powerful means for analyzing and solving complex, multi-step, real world problems. Students will also learn the appropriate use of technology, such as graphing calculators and spreadsheet utilities to model and analyze a wide range of mathematical relationships. In addition, students will explore radical expressions and statistics. Among the goals of this course is to explore real-world problems to improve their critical thinking and algebra skills while emphasizing the meaningfulness of algebra in their lives.

This course will focus on solving systems of equations, exploring linear, quadratic, exponential, and rational functions, and manipulating radical, polynomial, and rational expressions. Emphasis will be placed on the application of these concepts in real world settings and methods for modeling real world scenarios using these functions. Graphing calculators will be used throughout this course to further develop each concept. Students completing this course will take the NJSLA Exams in Algebra 1.

Prerequisite: Foundations of Algebra

New Jersey State Learning Standards

Summit Public Schools curriculum aligns with the [New Jersey Student Learning Standards](#).

Content Area Standards:

- A-APR.A.1. 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
- A-APR.B.3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
- A-CED.A.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 and exponential functions.
- A-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- A-CED.A.3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
- A-CED.A.4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R .
- A-REI.A.1. 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. Construct a viable argument to justify a solution method.
- A-REI.B.4. Solve quadratic equations in one variable.
 - a. 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. Derive the quadratic formula from this form.
 - b. 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. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b .
- A-REI.C.5+. 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.
- A-REI.C.6. Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.
- A-REI.C.7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.
- A-REI.D.10. 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 (which could be a line).
- A-REI.D.11. 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 $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
- A-REI.D.12. 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.

- A-SSE.A.2. Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.
- A-SSE.B.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression
 - a. Factor a quadratic expression to reveal the zeros of the function it defines.
 - b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
 - c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $(1.15^{(1/12)})^{(12t)} \approx 1.012^{(12t)}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.
- F-BFA.1. Write a function that describes a relationship between two quantities.
 - a. Determine an explicit expression, a recursive process, or steps for calculation from a context.
- F-BFA.2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- F-BFB.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.
- F-BFB.4. Find inverse functions.
 - a. 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. For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.
- F-IFA.1. 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. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.
- F-IFA.3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.
- F-IFB.4. 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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
- F-IFB.5. 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.
- F-IFB.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.
- F-IFC.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

- a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
- b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
- e. Graph exponential and logarithmic functions, showing intercepts and end behavior.
- F-IF.C.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.
- F-IF.C.8b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{(t/10)}$, and classify them as representing exponential growth or decay.
- F-IF.C.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 quadratic function and an algebraic expression for another, say which has the larger maximum.
- F-LE.A.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.
 - a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
 - b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
 - c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- F-LE.A.2. 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).
- F-LE.A.3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- F-LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context.
- N-RN.A.1. 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. For example, we define $5^{(1/3)}$ to be the cube root of 5 because we want $(5^{(1/3)})^3 = 5^{(1/3) \cdot 3} = 5^1 = 5$ to hold, so $(5^{(1/3)})^3$ must equal 5.
- N-RN.A.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents
- S-ID.A.1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
- S-ID.A.2. 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.
- S-ID.A.3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- S-ID.B.5. 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.

- S-ID.B.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
 - a. Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.
 - b. Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
 - c. Fit a linear function for a scatter plot that suggests a linear association
- S-ID.C.7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data
- S-ID.C.8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
- S-ID.C.9. Distinguish between correlation and causation.

Interdisciplinary Standards:

- RI.MF.9–10.6. Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.
- RST.9-10.7: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

Career Readiness, Life Literacies and Key Skills Standards:

- 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas
- 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option
- 9.4.8.DC.7: Collaborate within a digital community to create a digital artifact using strategies such as crowdsourcing or digital surveys.
- 9.2.12.CAP.10: Identify strategies for reducing overall costs of postsecondary education
- 9.1.12.CDM.2: Compare and contrast the advantages and disadvantages of various types of mortgages.
- 9.1.12.CDM.6: Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit. (e.g., student loans, credit cards, auto loans, mortgages, etc.).
- 9.1.12.PB.2: Prioritize financial decisions by considering alternatives and possible consequences.
- 9.1.12.PB.6: Describe and calculate interest and fees that are applied to various forms of spending, debt and saving.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
- 9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.

- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

Computer Science and Design Thinking Standards:

- 8.1.12.AP.5: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

Career Readiness Practices

- CRP 1. Act as a responsible and contributing citizen and employee.
- CRP 2. Apply appropriate academic and technical skills.
- CRP 3. Attend to personal health and financial well-being.
- CRP 4. Communicate clearly and effectively and with reason.
- CRP 5. Consider the environmental, social and economic impacts of decisions.
- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP 9. Model integrity, ethical leadership and effective management.
- CRP 10. Plan education and career paths aligned to personal goals.
- CRP 11. Use technology to enhance productivity.
- CRP 12. Work productively in teams while using cultural global competence.

New Jersey Curriculum Mandates:

This curriculum integrates lessons that address the following interdisciplinary New Jersey Curriculum Mandates:

- [Diversity and Inclusion](#) (Grades K - 12)
 - C.18A:35-4.36a: Curriculum to include instruction on diversity and inclusion.
 - (3) encourage safe, welcoming, and inclusive environments for all students regardless of race or ethnicity, sexual and gender identities, mental and physical disabilities, and religious beliefs.

Learning Objectives

Learning objectives are clear, specific statements that define what students should know, understand, and be able to do by the end of a lesson or course.

Students will...

- Determine whether a relation is a function.
- Identify and write the domain and range for discrete and continuous relations.
- Represent linear functions in multiple forms (table, graph, equation, verbal description).
- Model real-world situations and data using linear functions.
- Use function notation to evaluate, interpret, solve, and graph functions.
- Graph linear transformations including translations, stretches, shrinks, and reflections.
- Write and convert linear equations in standard, slope-intercept, and point-slope forms.
- Model and solve real-world problems using linear equations.

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- Identify and compare the slopes and characteristics of parallel and perpendicular lines.
- Construct and interpret scatter plots to analyze trends and make predictions.
- Write the explicit rule for an arithmetic sequence to find any specified term.
- Graph and analyze piecewise linear functions over given domains.
- Solve systems of linear equations using graphing, substitution, and elimination methods.
- Construct and solve systems of linear equations to model real-world problems with two variables.
- Identify systems of equations with one solution, infinite solutions, or no real solutions.
- Graph and identify the solution region for a system of linear inequalities.
- Convert expressions between radical form and rational exponent form.
- Identify the asymptote, domain, and restricted range of exponential functions.
- Determine the intervals where an exponential function increases or decreases across its domain.
- Compare geometric sequences to exponential functions with natural number domains.
- Classify, add, subtract, multiply, and apply polynomials to solve real-world problems.
- Factor polynomials using methods such as greatest common factor, grouping, and trinomial factoring.
- Apply the Zero Product Property to factored polynomials to solve real-world problems.
- Identify and apply special factoring patterns (difference of squares, perfect square trinomials).
- Explain how parameters a and c affect the vertical shift, stretch, shrink, and reflection of $f(x) = ax^2 + c$.
- Calculate the vertex and maximum/minimum value of a quadratic function in standard form using $(-b/2a, f(-b/2a))$.
- Identify the vertex (h, k) and transformations from the vertex form of a quadratic, $y = a(x - h)^2 + k$.
- Identify the x -intercepts of a quadratic function in intercept form, $y = a(x - p)(x - q)$.
- Convert quadratic functions between standard, vertex, and intercept forms.
- Compare and contrast key features of linear, exponential, and quadratic functions.
- Simplify radical expressions by removing perfect square factors from the radicand.
- Determine the solutions of a quadratic equation from its graph to analyze real-world contexts.
- Evaluate the form of a quadratic equation to select the most efficient solving method.
- Determine whether a quadratic equation has zero, one, or two real solutions.
- Solve quadratic equations using factoring, square roots, completing the square, and the quadratic formula.
- Graph square root and cube root functions using transformations.
- Simplify radical expressions prior to performing operations on them.
- Identify and explain extraneous solutions when solving radical equations.
- Find the inverse of a function algebraically and graphically by swapping input and output values.
- Calculate and describe data sets using measures of center and spread.
- Compute a five-number summary and measures of center using a graphing calculator.
- Construct and interpret box-and-whisker plots divided into quartiles.
- Describe and compare the shape of data distributions (skewed vs. symmetric).
- Organize, summarize, and evaluate categorical data using two-way frequency tables.

Units of Study

Units of study are organized collections of lessons and learning experiences focused on a specific topic and set of skills within a course. Each unit is guided by a set of essential questions.

Unit 1: Graphing Linear Functions (~11 Days)

- What is a function?
- What is a graph appropriate form for a given function?
- How are functions graphed based on the form?
- How can you determine whether a function is linear or nonlinear?
- How can you use function notation to represent a function?
- How can you describe the graph of the various types of linear functions
- How do the values of a , h and k affect the graph of the absolute value equation?

Unit 2: Writing Linear Functions (~9 Days)

- Given the graph of a linear equation, how do you write the equation of a line?
- How can you write the equation of a line given only certain characteristics?
- How can you recognize lines that are parallel and perpendicular, and what characteristics do they have?
- How can you use a scatter plot and line of fit to make conclusions about real-world data?
- How are arithmetic sequences used to describe patterns?
- How can you describe functions represented by more than one equation?

Unit 3: Systems of Equations (~11 Days)

- What does it mean to be a “solution”
- What are various ways to find solutions?
- What does a solution look like?
- Do all systems produce solutions?
- How are systems of equations and inequalities graphed?

Unit 4: Exponential Functions (~11 Days)

- How can you write general rules involving properties of exponents?
- How can you write and evaluate the n th root of a number?
- What are some of the characteristics of the graph of an exponential function?
- What are some of the characteristics of exponential growth and decay functions?
- How can you solve an exponential equation?
- How can you use a geometric sequence to describe a pattern?

Unit 5: Arithmetic and Geometric Sequences (6 Days)

- How can you use an arithmetic sequence to describe a pattern?
- How can you use a geometric sequence to describe a pattern?
- How do you use an explicit rule to write out the terms of an arithmetic / geometric sequence?
- How can you define a sequence recursively?
- How do you translate between recursive and explicit rules?
- How do you write the terms of a recursively defined sequence?

Unit 6: Polynomial Equations and Factoring (~14 Days)

- How can you add and subtract polynomials?
- How can you multiply two polynomials
- What are the patterns in the special products?
- How can you solve a polynomial equation?
- How do you factor a quadratic polynomial completely?

Unit 7: Graphing Quadratic Equations (~10 Days)

- What are the characteristics of the graph of a quadratic function?
- What are the different forms of a quadratic function?
- How does the form in which the quadratic function is given affect the method of graphing?
- How are the characteristics of quadratic functions applied to real-life problems (max/min, increasing/decreasing, y- and x- intercepts)?

Unit 8: Solving Quadratic Equations (~14 Days)

- How do you simplify square roots?
- How do you use a graph to solve a quadratic equation in one variable?
- How do you determine the number of solutions of a quadratic equation in standard form?
- How do you use completing the square to solve a quadratic equation?
- How do you apply the quadratic formula and what does it reveal about the quadratic?
- How do you determine the best method for solving any quadratic equation or nonlinear system involving quadratics?

Unit 9: Radical Functions (~13 Days)

- How can you simplify, multiply, divide, add, and rationalize denominators of radicals?
- What are some of the characteristics of the graph of a square root and cube root function?
- How can you solve an equation that contains square roots and cube roots?
- What is an extraneous solution?
- How are a function and its inverse related?

Unit 10: Data Analysis and Displays (~9 Days)

- How can you describe the variation of the data set?
- How can you use a box-and-whisker plot to describe a data set?
- How can you use a histogram to characterize the basic shape of the distribution?
- How can you read and make a two-way table?
- How can you display data in a way that helps you make decisions?

Unit 10: Probability (~9 Days) - If time permits

- How can you list and organize all possible outcomes in the sample space of an experiment?
- How do theoretical probability and experimental probability differ, and how does performing more trials affect their relationship?
- How can you determine whether two events are independent or dependent, and how does that affect calculating their probability?
- How can two-way tables, tree diagrams, and Venn diagrams be used to represent complex probabilities and analyze real-world data?

Instructional Resources and Materials

Instructional resources are the information sources teachers utilize to guide their teaching and assessing. Instructional materials are the texts students read or review. The instructional resources and materials may vary in order to meet the learning needs of students.

- Textbook: *Big Ideas MATH* (A Common Core Curriculum) - Ron Larson & Laurie Boswell (2014)
- Guided Note Outlines
- Google Classroom
- DeltaMath
- Desmos
- Khan Academy
- NJ Standardized Test Prep Resources
- Kuta Software

Assessment Strategies

Assessment measures a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes and for evaluative purposes. Teachers may choose one or more of the following ideas to assess learners. They may also modify these ideas to make the assessment more responsive to students' interests and needs.

Formative:

Practice Problem Sets,
Homework Exercises,
Exit Tickets,
Graded Check-Ins

Summative:

Quizzes
Unit Tests
Midterm
Final Exams

Benchmark:

Pre/Post Test
Mastery Quizzes

Alternative: Projects

Suggested Strategies for Modification & Differentiation

[Modifications Chart](#)

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Multilingual Learners

Please note this curriculum can be modified for Multilingual Learners for the Sheltered Algebra 1 course