Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Mathematics
Course: Algebra 1 Enriched (MA803)
Grade(s): 8

Course Overview

This course represents a comprehensive Algebra I course. It has been designed to offer a rigorous and challenging curriculum that meets the New Jersey Student Learning Standards. The course covers a wide range of topics but also investigates each topic in great depth. Students will be expected to master the skills necessary to continue successfully into higher-level mathematics courses in subsequent years. Students will learn the algebraic properties necessary to solve a variety of problems including multi-step, absolute value, and quadratic equations. They will learn to represent a variety of functions graphically and algebraically. These functions will include linear, quadratic, absolute value, and exponential. The rules and patterns of exponents will be explored and students will use exponents to model real world situations like exponential decay/growth and compound interest. Students will learn how to solve quadratic equations using both factoring and the quadratic formula. They will explore the characteristics of graphs of quadratic functions and how these graphs relate to equations and solutions. Students will explore radical expressions and fractional roots. They will learn how to simplify radical expressions and rationalize these expressions. They will also learn about polynomials and various operations using polynomials. This will include addition, subtraction, multiplication, and division of polynomial expressions. Throughout all of these topics critical thinking and problem solving skills will be emphasized. Students will be expected to apply their knowledge to real and relevant problems. Students will also learn the appropriate use of technology, such as graphing calculators and web-based utilities to model and analyze a wide range of mathematical relationships.

Prerequisite: Accelerated Math 6

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.APR.D. Rewrite rational expressions.

- 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.A.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- A.REI.B.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- 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 ± 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.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.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.1. Interpret expressions that represent a quantity in terms of its context.
- 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.
- F.IF.A.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.IF.A.2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- F.IF.B.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.IF.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.
- F.IF.C.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
    - b. 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.
- F.LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context.
- G.SRT.B.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
- N.Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
- N.Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- 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^(⅓) to be the cube root of 5 because we want (5^(1/3))^3 = 5^(1/3)^3 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.
- N.RN.B.3. 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; and that the product of a nonzero rational number and an irrational number is irrational.
- N.VM.C.6+. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
- N.VM.C.7+. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
- N.VM.C.8+. Add, subtract, and multiply matrices of appropriate dimensions.

Interdisciplinary Standards:

- MS-PSI-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
- MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
- MS-ESSI-3. Analyze and interpret data to determine scale properties of objects in the solar system.
- MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
- MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ETSI-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Career Readiness, Life Literacies and Key Skills Standards:

- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
- 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.
- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping
- 9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations.
- 9.4.8.IML.5: Analyze and interpret local or public data sets to summarize and effectively communicate the data
- 9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
- 9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem

Computer Science and Design Thinking Standards:

- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.
- 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.

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 understand that…

- Use algebraic techniques and properties to set up equations, translate words into symbols, and translate problems into equations.
- Apply dimensional analysis strategies to facilitate computations.
- Understand solving equations as a process of reasoning and explain the reasoning
- Interpret the structure of expressions
- Difference between rational and irrational numbers and understand the types of answers produced when working with different numbers
- Construct algebraic equations to represent patterns and real-world problems.

- Use algebraic techniques and properties to set up equations, translate words into symbols, and translate problems into equations.
- Recognize equivalent expressions and equations.
- Use equations and inequalities to model and solve real-life problems
- There are often more than one possible solution to real life situations and inequalities can best model those examples.
- Compound inequalities result in sets of numbers as their solution. The intersection and union of sets is modeled by “and” and “or” problems respectively.
- Slope determines the orientation of a line, while the y-intercept determines its relationship with the y-axis.
- Linear equations can be written in a variety of forms, with each having instances when they are most beneficial.
- Linear and nonlinear equations have defining characteristics in their equations and graphs.
- Nonlinear graphs can be graphed using tables or patterns.
- Understand the definition and characteristics of a function
- Compare the properties and characteristics of different functions including their graphs and equations.
- Construct functions in a variety of manners to represent the relationship between two quantities.
- Distinguish situations that can be represented with linear versus exponential functions.
- Solve quadratic equations in one variable using a variety of methods.
- Systems of equations are useful to model real life situations.
- There are three methods to solve systems: Graphing, substitution, and Linear Combinations Elimination. Each produces the same result.
- Systems of linear equations can result in no solution, one solution, or infinite solutions.
- Systems of nonlinear equations can have more than one solution.
- A negative exponent is just another way to represent the reciprocal of a quantity.
- Exponential growth and decay models give meaning to many situations in real life, especially in finance and microbiology.
- When raising a quantity to a power, you can only distribute the exponent through a monomial; if the quantity in parentheses is a binomial or polynomial, this method will not work.
- We use scientific notation to make it easier to read and write really large or small numbers. The calculations for scientific notation follow the properties of exponents.
- The intercepts, or zeros, of a quadratic function are the solution sets, and show us where a parabola crosses the x-axis.
- Quadratic equations are symmetric in nature
- Polynomials should be written in descending order of degree
- The leading coefficient, a, determines the orientation and width of the parabola
- The intercepts, or zeros, of a quadratic function are the solution sets, and show us where a parabola crosses the x-axis.
- Quadratics can be used to model the effects of gravity on an object.
- Vertex form of a quadratic can be used to graph and solve.
- Proportionality helps to represent similar figures used in models of real life objects.
- Factoring is used to ensure rational expressions are in their simplest form.
- Rational expressions must have a common denominator to add or subtract.

- Simplifying a rational expression before multiplying or dividing is needed to have the answer in simplest form.

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: Properties of Equality, Number System, and Introduction to Matrices (~15 Days)

- How are verbal and algebraic models and formulas used to represent real life situations?
- How can the result of an equation be checked?
- How can the opposite of a quantity be written in different formats?
- Are there any characteristics of expressions to help identify opposites?
- How are matrices arranged and named?
- How can you determine if matrix multiplication will result in a defined solution?
- What type of answer will result when you perform different operations on rational vs. irrational numbers?

Unit 2: Solving Equations, Rate Problems, Absolute Value Equations (~12 Days)

- How are verbal and algebraic models and formulas used to represent real life situations?
- How can units of measure be used to make problem solving decisions?
- How can rates, ratios, percents, and proportions be applied to problem solving?
- How are absolute value and squared quantity equations similar in their method of solving?
- Why is there sometimes more than one solution to absolute value or squared quantity equations?

Unit 3: Inequalities (~13 Days)

- What is my solution set for an inequality?
- What does it look like graphically?
- How does a compound “and” inequality differ from an “or” inequality?
- What effect does the absolute value function have on an inequality?
- How do calculations affect an inequality statement?

Unit 4: Equations and Graphs (~14 Days)

- How do I model a linear relationship graphically?
- What does “slope” mean in a linear equation?
- Which method is the most efficient and appropriate method to graph a linear function?
- What is the relationship between Slope-Intercept Form, Point-Slope Form, and Standard Form? When is each most useful?

Unit 5: Formulas and Quadratics (~16 Days)

- What is a function and how can it be represented graphically, algebraically, or with other methods?
- How can functions be used to represent bi-variate data?
- How does the addition or subtract of constants to a function change it’s graph?
- When is it appropriate to use linear functions versus a quadratic or exponential function?
- How can you use linear, quadratic, and exponential functions to solve real-world problems?

- How are the solutions to a quadratic equation represented on a graph?

Unit 6: Systems of Equations (~10 Days)
- Given any two lines, how many different possibilities are there to describe their intersection?
- When is it useful to determine the solution set of two linear relationships?
- How are the solutions to systems of equations and inequalities similar and different?

Unit 7: Exponents (~18 Days)
- What does it mean for something to grow exponentially?
- What does a negative exponent represent?
- How can roots be represented as an exponent?

Unit 8: Polynomials and Factoring (~17 Days)
- What types of situations can be modeled by a quadratic equation?
- How do we utilize factoring a quadratic? What do the intercepts tell me?
- What are the different methods to solve a quadratic, and when would I employ each method?

Unit 9: Graphing Nonlinear Functions and Projectile Motion (~11 Days)
- Describe what characteristics of a quadratic would help you to determine when to use the different methods of solving?
- What is the purpose of completing the square of a quadratic?
- How are absolute value and quadratics graphs similar or different?

Unit 10: Rational Expressions and Equations (~14 Days)
- Why is factoring important when simplifying rational expressions?
- Why do we include a list of restrictions on the value of the variable when simplifying a rational expression?
- How are direct and inverse variations represented in equations and graphs?

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.

- Guided Note Outlines
- Google Classroom
- DeltaMath
- Desmos
- Khan Academy
- NJ Standardized Test Prep Resources
- Kuta Software
- Textbook Resource: Algebra 1: An Integrated Approach (McDougal, Littell & Co. 1991)

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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

Benchmark: Midterm and Final Exams

Alternative: Projects

Suggested Strategies for Modification & Differentiation

Modifications Chart