Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Mathematics
Course: Foundations of Algebra (MA802)
Grade(s): 8

Course Overview

This course represents the first part of a two-year course. It has been designed to offer a rigorous and comprehensive foundation that addresses the New Jersey Student Learning Standards for Mathematics for Grade 8. It will also provide students the opportunity to truly master algebraic and mathematics skills that will lead to greater achievement in subsequent courses. Students will create and use numerical, algebraic, graphical, and verbal representations and analyze sophisticated patterns, relations, and functions. They will represent linear functions numerically, algebraically, graphically and verbally and work with and interpret these representations. They 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. Functions will be introduced 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

Prerequisite: Pre-Algebra 7

New Jersey State Learning Standards

Summit Public Schools curriculum aligns with the New Jersey Student Learning Standards,

Content Area Standards:

- 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.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- 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.

- 8.EE.A.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 × 3^(−5) = 3^(−3) = 1/3^(3) = 1/27
- 8.EE.A.2. Use square root and cube root symbols to represent solutions to equations of the form x^2 = p and x^3 = p, where p is a positive rational number.
    - a. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
    - b. Simplify numerical radicals, limiting to square roots (i.e. nonperfect squares). For example, simplify $\sqrt{8}$ to $2\sqrt{2}$.
- 8.EE.A.3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 × 10^8 and the population of the world as 7 × 10^9, and determine that the world population is more than 20 times larger.
- 8.EE.A.4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
- 8.EE.B.5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed
- 8.EE.B.6. Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.
- 8.EE.C.7. Solve linear equations in one variable
    - a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. 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).
    - b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
- 8.EE.C.8. Analyze and Solve Pairs of Simultaneous Linear Equations
    - a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
    - b. Solve systems of two linear equations in two variables using the substitution method and estimate solutions by graphing the equations. Solve simple cases by inspection. For example: by inspection, conclude that 3x+2y=5 and 3x+2y=6 have no solution because 3x+2y cannot simultaneously be 5 and 6. Solve 3x+y=30 and y=2x using the substitution method; Solve y=3x+1 and y=-2x+7 using the substitution method.
    - c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine

whether the line through the first pair of points intersects the line through the second pair.

- 8.F.A.1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
- 8.F.A.2. Compare properties (e.g. rate of change, intercepts, domain and range) of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
- 8.F.A.3. Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s^2 giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.
- 8.F.B.4. 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. Interpret 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.F.B.5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
- 8.G.A.1. Verify experimentally the properties of rotations, reflections, and translations:
    - a. Lines are transformed to lines, and line segments to line segments of the same length.
    - b. Angles are transformed to angles of the same measure.
    - c. Parallel lines are transformed to parallel lines.
- 8.G.A.2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
- 8.G.A.3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
- 8.G.A.4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
- 8.G.A.5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angleangle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.
- 8.G.C.9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
- 8.G.B.6. Explain a proof of the Pythagorean Theorem and its converse
- 8.G.B.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

- 8.G.B.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
- 8.NS.A.1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.
- 8.NS.A.2. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations
- 8.SP.A.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
- 8.SP.A.2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit (e.g. line of best fit) by judging the closeness of the data points to the line.
- 8.SP.A.3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.
- 8.SP.A.4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?

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.

Date Revised: August 2025

- 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…

- The Order of Operations can be applied to more complex problems.
- Inverse operations can be used to keep an equation balanced and isolate a variable.
- Some equations will have an infinite number of solutions
- Some equations will have no solution.
- Inequalities follow a similar structure and order as equations.
- Solutions to inequalities represent a boundary and may be infinite.
- Compound inequalities allow for more than one boundary and may be a representation of a union or intersection of the solution sets.
- Functions have specific characteristics, that each element of the domain has one matching element of the range.
- Functions can be represented as equations, tables, or graphs.
- The slope of the line represents a constant rate of change.
- Linear equations can be used to model a variety of real life situations.
- The slope of a line represents a rate of change, and controls the steepness of its graph.
- Linear equations can be manipulated using inverse operations to convert between formats.
- The y-intercept of a linear graph occurs when the x-value is 0 and is a common starting point for real life problems.
- Trend lines of scatter plots can often be represented by linear equations.
- Trend lines of scatter plots can be used to predict and draw conclusions from data.
- Looking only at quantities of data values in a two-way table can be misleading; relative frequencies adjust for this by taking into account the total number of data values.
- A system of linear equations can have one solution, no solution, or infinite solutions.
- Systems of equations can be solved by graphing, using substitution, or by using elimination.
- Graphs of systems of equations can have one point of intersection, no points of intersection, or infinite points of intersection.
- Rotations, Reflections, and Translations of two-dimensional figures result in congruent figures.

- Dilations of two-dimensional figures result in similar figures.
- The rules of exponents allow modeling of repeated multiplication.
- Exponents can be used to model and solve growth and decay situations, including compound interest.
- Square and cube roots can be used to solve exponential equations.
- Many square and cube roots are irrational numbers that can be estimated.
- Some square roots that are irrational can be simplified using factors that include perfect squares.
- The Pythagorean Theorem can be used to find the missing sides of right triangles and model geometric objects.
- Angle relationships are formed when parallel lines are cut by a transversal.
- The exterior angle of a triangle is equal to the sum of the remote interior angles of the triangle.
- Cones and cylinders use similar volume formulas, with cones being ⅓ that of a related cylinder.
- Volume units use cubic powers due to the three dimensional nature of volume.
- The characteristics of linear inequalities and their representations are useful in solving real-world problems.
- Most systems of linear inequalities have infinite solutions.
- Systems of linear inequalities are solved by graphing and shading the region of the graph that contains the coordinates that make the inequality true.
- Systems of linear inequalities are used to model and solve real-world problems involving two variables.

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: Solving Linear Equations (~16 Days)

- How does one apply the order of operations in complex, multi-step problems?
- How can one model real life situations with equations?

Unit 2: Solving Linear Inequalities (~12 Days)

- What does an inequality represent?
- How can we determine if the boundary is included in the solution set?
- How can we use mathematical models to represent inequalities?
- What is the difference between the different types of compound inequalities?
- How can the different types of compound inequalities' solution sets be displayed on a number line?
- How are absolute value inequalities related to compound inequalities?

Unit 3: Identifying and Graphing Linear Functions (~19 Days)

- What characteristics of a relation makes it a function?
- How can you identify a function when given a table, graph, or equation?
- How can you calculate the slope of a line?
- What does the slope of the line represent?

- How do the different parts of a linear equation translate to a graph or table?

Unit 4: Writing Linear Functions (~10 Days)
- How are the slope and y-intercept of a linear function represented on a graph?
- How are the slope and y-intercept of a linear function represented in an equation?
- How are the different forms of linear equations related?
- What are the advantages and disadvantages of each form of linear equations?
- How can linear equations be used to model trends in sets of data?
- What are the common characteristics of parallel and perpendicular lines when using graphs or equations?
- How can you determine if there is an association between two variables from a two-way table?

Unit 5: Solving Systems of Linear Equations (~13 Days)
- Where on a graph can you identify the coordinate that is a solution to more than one equation simultaneously?
- How can one use the rules of algebra to solve for the coordinate that is the solution to a system of equations?
- What does the graph of a system of equations with infinite or no solutions look like?
- What does the algebraic solution for infinite or no solution systems look like?

Unit 6: Transformational Geometry (~10 Days)
- Does translating, rotating, reflecting, or dilating change the size of a two-dimensional figure?
- How can you use a series of transformations to create different shapes?

Unit 7: Exponents, Roots, & Pythagorean Theorem (~21 Days)
- How can the rules and properties of exponents be used to simplify expressions?
- How can exponents be used to model growth and decay?
- What are the practical applications and rationale for using Scientific Notation when writing numbers?
- What is an irrational number?
- How can Pythagorean Theorem be used to model real life objects?

Unit 8: Plane/Three-Dimensional Geometry (~19 Days)
- How can you describe angles formed by parallel lines and transversals?
- How are the interior and exterior angles of triangles related?
- How does changing one dimension of a cylinder, cone, or sphere affect its volume?

Unit 9: Linear Inequalities and Systems (~8 Days)
- How does the graph of a linear inequality in two variables help to identify the solutions of the inequality?
- How does solving a system of linear inequalities differ from solving a system of equations?
- How does the graph of a system of linear inequalities relate to the solutions of the system?
- When would it be useful to solve a system of linear inequalities?

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: Big Ideas Math: Algebra 1, 2019

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