



Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Mathematics

Course: Algebra 2 (H245)

Grade(s): 10-12

Course Overview

This course is for the college-preparatory student with average mathematical ability who has successfully completed Algebra 1 and Geometry. Students with above-average mathematical ability who have an interest in mathematics (or science-related careers) should consider the Algebra2/Trigonometry course. This course is a continuation of work begun in Algebra I. It emphasizes facility with algebraic expressions and forms, especially linear and quadratic forms, powers and roots, and functions based on these concepts. Students study exponential, logarithmic, polynomial, and other special functions for their abstract properties and as tools for modeling real-world situations. Geometric ideas are utilized throughout, and matrices are examined conceptually and applied. Students completing this course will take the NJSLA Exams in Algebra 2.

Building on the understanding of linear, quadratic and exponential functions from Algebra I, this course will extend function concepts to include polynomial, rational, and radical functions. The standards in this course continue the work of modeling situations and solving equations.

Prerequisite: Geometry

New Jersey State Learning Standards

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

Content Area Standards:

- A-APR.C.4+. Prove polynomial identities and use them to describe numerical relationships.
- A-CED.A.1 - Create equations and inequalities in one variable and use them to solve problems.
- 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 non-viable options in a modeling context.

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- A-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- 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.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. A-REI 4.
 - 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.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.9+. 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).
- 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. Interpret parts of an expression, such as terms, factors, and coefficients
- 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-BFA.1b) Combine standard function types using arithmetic operations.
- F-BFA.1c) (+) Compose functions. For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.
- F-BF.B.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-BF.B.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.
- 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.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.
- F-IF.C.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.8. a) 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-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.
- N-CN.A.1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
- N-CN.A.2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
- 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 $(5^{1/3})^3 = 5(1/3)^3$ 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. Use properties of rational and irrational numbers.
- N-RN.A.3. Simplify radicals, including algebraic radicals (e.g., simplify $\sqrt{2}$).
- 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.
 - b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

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 understand that...

- Using inverse operations, you can solve for the variable.
- By solving an equation for one variable, it allows you to find another measurement easily.
- Absolute value represents the distance from 0. Therefore when you solve absolute value equations, you often have two solutions.
- These types of notations are ways of showing solutions over a set of numbers.
- An “and” inequality determines the intersection between two inequalities whereas an or inequality shows the union of two inequalities.
- Domain refers to x values whereas the range refers to the y values.
- Rational functions and square root functions are the most notable functions that have restricted domains
- Situations that grow or decline at a constant rate are linear relationships.
- The slope compares the vertical height to the horizontal height. Rate of change is often used to look at the slope over a given time period.
- The slope intercept form of an equation has y solved for and is set = to the slope per x plus or minus the y-intercept. ie $y = mx + b$
- A piecewise function is two or more functions examined on the same graph but are contained by a certain interval.
- Using parent graphs and rules of vertex form, any function can be manipulated to be easily graphed.
- To find the inverse of a function, simply switch the input and output.
- A system of equations can have one solution (ie. there is exactly one point that each line shares).
- A system of equations can have an infinite number of solutions (ie. the linear functions share all points because the lines share a common slope and y-intercept).

- A system of equations can have no solution (ie. the lines share no common points because the lines share a common slope but a different y-intercept).
- That the rules for powers are derived from basic concepts:
 - adding powers
 - subtracting powers
 - negative exponents
 - zero power
 - multiplying powers
- A polynomial times another polynomial, “Foiling”, is simply the act of distributing the terms in the first polynomial to the terms in the other polynomial.
- Factoring is the process of breaking down a polynomial into the multiplication of two or more polynomials or monomials. Just like a number can be broken down into it’s primes, a polynomial can be broken down it’s composite terms.
- The radical is the symbol, square root is the operation of that produces the number that is being multiplied by itself.
- Just like variables must be alike to combine like terms, so must radicals as they too are two numerical values being multiplied together.
- i represents the square root of negative 1. Imaginary numbers are part of the complex number system
- Roots are solutions to a quadratic equation. They are also known as zeros.
- A root can be found where the quadratic function crosses the x-axis.
- A quadratic function can have 0, 1 or 2 real roots. If a function has zero real roots, then the roots to the function are, in fact, imaginary.
- A function that models repeated multiplication (ie, have a input variable as the exponent) is an exponential function.
- Money is a great example of exponential growth. Interest is often compounded. This is how people earn money on investments.

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: Equations and Problem Solving (~7 Days)

- How do you solve linear equations with one variable?
- How can you use a formula for one measurement to write a formula for a different measurement?
- What is absolute value?

Unit 2: Inequalities (~7 Days)

- What are set notation and interval notation?
- What is the difference between an “and” inequality and an “or” inequality?

Unit 3: Functions (~7 Days)

- What is domain and range? Are there ever any values that cannot be in the domain of a function?

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Unit 4: Linear Functions (~10 Days)

- What types of situations are modeled by linear relationships?
- How do you calculate slope and rate of change from a graph or model?
- What is the slope intercept form of an equation?

Unit 5: Extension of Functions (~10 Days)

- What is a piecewise function?
- What is vertex form and how can it be applied to functions?
- How do you find the inverse of a function?

Unit 6: Systems of Equations (~14 Days)

- How many solutions can exist given a system of equations?
- How can solutions to linear help with cost effectiveness?

Unit 7: Exponents (~18 Days)

- Where are the power rules for monomials derived from?
- How can we apply the distributive property to polynomial multiplication?
- What is factoring and what is the relationship between a polynomial and its factors?

Unit 8: Radicals and Rational Exponents (~16 Days)

- What is the difference between a radical and a square root?
- Why is it necessary for roots to “match” in order to add or subtract radicals?
- What is i ?

Unit 9: Quadratic Equations (~21 Days)

- What does it mean to be a root to a quadratic equation?
- What are ways we can find roots?
- How many roots does a quadratic equation have?

Unit 10: Exponential Growth and Decay (~7 Days)

- What is an exponential function?
- How do exponential functions relate to money?

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](#)

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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](#)