Mathematics Department

Course: Integrated Algebra- Brief Description

Integrated Algebra is designed for students who have completed Algebra I and Geometry, but experienced difficulties, particularly in Algebra 1. The course aims to provide both a thorough review and reinforcement of algebraic skills and concepts from Algebra I and an extension of such topics. This course will require students to review and extend algebraic and equation-solving techniques for linear, quadratic, and polynomial equations, as well as for systems of equations. Students will use function notation and will analyze and graph linear and quadratic functions. Real-life applications are integrated within each unit of study. Students will also review skills and problem-solving strategies in preparation for standardized and required assessments. 77 Successful completion of this course will be measured through teacher-generated assessments, projects, and assignments. This course can be counted in partial fulfillment of the state-mandated fifteen (15) credits of mathematics.

Developed by: Jessica Mabel, Leann Martin
Supported by: David Sorensen, Lauren Kosakowski
Effective: September 2023

Scope and Sequence

Month	Integrated Algebra
September	**Prerequisites - (No Calculators Prefered)** -Add/Sub/Mult/Divide Integers, fractions, and decimals - Order of Operations **Unit 1: Degree One: Linear** - Solve linear equations using add/sub/mult/division - Solve a formula for one of its variables -Identify linear functions and linear equations -Find x- and y-intercepts to graph lines and interpret their meanings in real-world situations -Find rates of change and slopes

	-Write and graph a linear equation in slope-intercept form -Graph a line and write a linear equation using point-slope form -Identify, graph, and write equations of parallel and perpendicular lines. -Describe how changing slope and y-intercept affect the graph of a linear function. -Solve systems of equations by graphing, elimination, and substitution
October	**Unit 2: Degree 2: Quadratics** **Factoring Quadratic Expressions** -Find the GCF of monomials -Factor polynomials by using the greatest common factor -Factor polynomials by grouping -Factor quadratic trinomials -Factor perfect-square trinomials and the difference of two squares
November	**Unit 2: Degree 2: Quadratics (Cont.)** **Solving Quadratic Equations** - Find the roots of a quadratic equation by factoring. - Solve quadratic equations by taking the square root of both sides. - Perform operations on complex numbers. - Solve quadratic equations by completing the square. - Use completing the square to write quadratic functions in vertex form $y = a (x – h)^2 + k$.
December	**Unit 2: Degree 2- Quadratics - (Cont.)** **More Solving Equations and Connection to Related Functions** - Solve quadratic equations using the quadratic formula. - Find the discriminant of a quadratic equation and use the value to describe the nature of the solutions and to choose the best method for solving. - Write and graph quadratic functions in standard form ($y = ax^2 + bx + c$), vertex form ($y = a(x – h)^2 + k$), and intercept form ($y = a(x – p)(x – q)$). - Solve quadratic inequalities in one variable by graphing and algebraically.
January	**Unit 2: Degree 2-Quadratics (Cont)** **More Functions and Graphing** - Find the vertex, axis of symmetry, domain and range, x and y intercepts of quadratic functions. - Graph Quadratic functions in standard form, vertex form, and intercept form. - Solve quadratic inequalities in one variable by graphing and algebraically.

	- Graph quadratic inequalities in two variables to show all solutions. - Use quadratic equations, inequalities, and functions to model and solve real-life problems.
February	**Unit 3: Polynomials** **Polynomial Expressions-Polynomial Operations** Evaluate and simplify expressions containing the laws of exponents. - Evaluate and simplify expressions containing rational exponents - Classify polynomials - Add/subtract/multiply polynomials - Divide polynomials using long and synthetic division.
March	**Unit 3: Polynomials (Continued)** **More Factoring and Solving- (Degree of 2 and higher)** - Evaluate a polynomial function by direct substitution and synthetic substitution. - Factor polynomial expressions of higher degree. - Factor difference and sum of cubes. - Use factoring methods to solve polynomial equations. - Relate the results of division to the solutions of a polynomial equation and to The Remainder and Factor Theorems.
April	**Unit 3: Polynomials (Cont)** **Connection to Related Functions and Graphs** - Use the Fundamental Theorem of Algebra to determine the number of zeros of a polynomial function. - Use The Rational Zero Theorem to identify possible rational zeros of a polynomial function. - Use all of the above to identify all zeros of a polynomial function, real and imaginary, and to sketch a graph. - Use polynomial equations and functions to model and solve real-life problems.
May	**Units 1, 2, and 3: Review of Properties of All Functions** - Identify functions - Represent and evaluate functions using mappings, ordered pairs, tables, and graphs - Find the domain and range of relations and functions - Write an equation in function notation and evaluate a function for given input values

June	**Unit 4: Roots and Rational Exponents** -Evaluate *n*th roots of real numbers using both radical and rational exponent notation. -Apply the properties of exponents to simplify and evaluate expressions containing rational exponents. -Graph square root and cube root functions. -Solve equations that contain rational exponents and radicals. **FINAL REVIEW**

Unit 1	
Degree One: Linear	
Summary and Rationale	
Students will solve linear equations through the use of the properties of real numbers and equality, inverse operations, and other algebraic properties to transform an equation into equivalent and more simple equations in order to isolate the variable and determine a solution(s). Students will use this process to solve one-step, two-step, and multi-step linear equations, and equations with variables on both sides.. Students will take a closer look at the characteristics and properties of linear functions, and their equations and graphs. Students will learn how the slope of a line affects its graph, different graphing methods, and how to write and obtain important information from linear equations in different forms. Students will solve systems of linear equations using the methods of graphing, elimination and substitution.	
Recommended Pacing	
September	
Standards	
Algebra	
A-CED-1	Create equations and inequalities in one variable and use them to solve problems.
A-CED-2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A-CED-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.
A-CED-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-1	Explain each step in solving a simple equation as following from the equality of numbers asserted in 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-3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
A-REI-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-6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
A-REI-7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.
A-REI-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).
Functions	
F-IF-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-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-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-5	Relate domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
F-IF-6	Calculate and interpret the average rate of change of a function over a specified interval. Estimate the rate of change from a graph.
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. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Write exponential and logarithmic functions, showing intercepts and end behavior, and

	trigonometric functions, showering period, midline, and amplitude
F-IF-8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the functions. 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. Use the properties of exponents to interpret expressions for exponential functions.
F-IF-9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
F-LE-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. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
Number and Quantity	
N-Q-1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
Geometry	
G.CO.1	Know precise definitions of angles, circle, perpendicular line, parallel line and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
G.CO.2	Represent transformations in the plane, describe transformations as functions that take points in the plane as inputs and give other points at outputs.Compare transformations that preserve distance and angle to those that do not (e.g. translation vs. horizontal stretch)
G.GPE.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
Interdisciplinary Connections	
RL.10	Read and comprehend complex literary and informational texts independently and proficiently.

W.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
9.1	All students will demonstrate the creative, critical thinking, collaboration, and problem solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.
Integration of Technology	
8.1.8.A.5	Select and use appropriate tools and digital resources to accomplish a variety of tasks and to solve problems.
Career Readiness, Life Literacies and Key Skills	
9.1.12.EG.1	Review the tax rates on different sources of income and on different types of products and services purchased.
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.4	Evaluate different careers and develop various plans.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities.
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition.
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.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task.
9.4.12.TL.2	Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of a collaborative environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**

All equations of degree one or higher are defined as polynomial equations. Linear equations are degree one, so most yield at most one real solution. Solving a linear equation is the process of rewriting the equation (or inequality) to make what it says about its variable(s) as simple as possible. Properties of numbers and equality can be used to transform an equation into equivalent, simpler equations in order to find solutions. Properties of real numbers and equality, along with the use of inverse operations, can transform an equation into one or a series of equivalent simpler equations. The properties of real numbers and equality can be used repeatedly to isolate the variable. This process is used to find solutions to one-variable equations. The process is also used to isolate a particular variable in a formula that contains two or more variables. A linear relationship can be represented using three equation forms: slope-intercept form, point-slope form, and standard form. All forms are useful in writing the equations of linear functions given a graph or certain characteristics and also provide effective and efficient graphing methods. The particular form of a linear equation often suggests a particular graphing method. The standard form makes it easy to find x and y intercepts and draw graphs quickly using two points. The slope-intercept form makes it possible to graph the line easily starting with one point and obtaining several others by moving according to the slope. The relationship between two lines can be determined by comparing their slopes and y-intercepts obtained from graphs or equations. The solution of a system of equations is the set of ordered pairs that satisfy both equations in the system. When solving a system of linear equations, there are possible types of solutions: one solution (the point of intersection of the two lines), no solution (The lines do not intersect.), or an infinite number of solutions (The equations in the system represent the exact same line.) Systems of equations can be solved in more than one way. Three methods are graphing, substitution, and elimination. The best method to use depends on the forms of the given equations and how precise	Can linear equations that appear to be different be equivalent? How can you solve linear equations? What does the slope of a line indicate about the line? What information does the equation of a line give you? How can you represent linear relationships on a graph? How can you represent and describe linear functions? Can functions model real-world situations? How can you solve a system of equations? Can systems of equations model real-world situations? When and how do you know when the use of one method is more efficient than another for a particular linear system? How can you represent linear relationships (or functions) on a graph? How can you represent and describe linear functions? Can linear functions model real-world situations?

the solution should be. The graphing method involves graphing each equation and finding the intersection point, if one exists. When a system has at least one equation that can be solved for a variable, the system can be efficiently solved using substitution. Some equations of a system are written in a way that makes eliminating a variable the best method to use.

A function is a relationship between variables in which each value of the input variable (value in the domain) is associated with a unique value of the output variable (value in the range.) In order to determine if an equation or a set of ordered pairs represents a function, the solutions of the equation or the ordered pairs can be organized in a table or plotted on a graph. If the table of values shows that each value in one set is paired with exactly one value in the other set, the relation is a function. The vertical line test uses the graph to determine whether a relation is a function.

A linear function is a function whose graph is a line. A nonlinear function is a function whose graph is not part of a line. Linear functions can be represented in a variety of ways, such as words, tables, two-variable equations or rules, sets of ordered pairs, and graphs. Each representation is particularly useful in certain situations.

Many real world mathematical problems can be modeled and represented algebraically and graphically by linear equations and functions. A function that models a real world situation can be represented using an equation or graph that can be used to make estimates or predictions about future occurrences. A real-world graph of a function should only show points that make sense in the given situation.

Real world problems can be modeled and solved using linear equations, functions, and systems of equations.

Evidence of Learning (Assessments)

Tests
Quizzes
Homework
Class participation

Objectives (SLO)

Students will know:	Students will be able to:
· Linear Expressions · Linear Equations · Linear Functions · Graphs of Lines · Slope · System of Linear Equations · Point of Intersection · Substitution method · Elimination method	-Solve linear equations using add/sub/mult/division - Solve a formula for one of its variables - Identify linear functions and linear equations -Find x- and y-intercepts to graph lines and interpret their meanings in real-world situations -Find rates of change and slopes -Write and graph a linear equation in slope-intercept form -Graph a line and write a linear equation using point-slope form -Identify, graph, and write equations of parallel and perpendicular lines. -Describe how changing slope and y-intercept affect the graph of a linear function. -Solve systems of equations by graphing, elimination, and substitution

Suggested Resources/Technology Tools

-Textbooks, workbooks, and assessment aides
-Online textbook
-NJSLA Practice Tests and Released Items
-Khan Academy; www.insidemathematics.org/performanceassessment-tasks
-Calculators when specified
-Google Classroom
-Desmos graphing calculator
-Kuta Software

Tier 1 Modifications and Accommodations

Including special education students, Multilingual Language Learners (MLLs), students at risk of school failure, gifted and talented students, and students with 504 plans;

General Modifications for students struggling to learn:
Small group instruction within the classroom
Differentiation through content, process, product,and environment
Individual feedback and praise towards what is done correctly based upon effort, attitude and strategy.
Help students manage individual stressors for the student and plan alternate pathways for completion of assignments.

Special Education:
Modifications are determined by each student's Individual Education Plan. Examples include:
-Use concrete examples of concepts before teaching the abstract
-Reduce the number of concepts presented at one time
-Give additional presentations by varying the methods using repetition, simpler explanations, more examples and modeling
-Use of aids (calculator, computer, tape recorder, etc.)
-Frequently check on progress of independent work
-Provide study guides and copy of notes
-Provide repetition and practice

MLL:
Modifications are determined by each student. Examples include:
- Provide students with notes, examples, tests, and quizzes in their primary language
- Monitor the student's comprehension of language used during instruction
- Give written directions to supplement verbal directions
- Frequently check on progress of independent work

504:
Modifications are determined by each student's 504 plan. Examples include:
-Teacher will review, restate and repeat directions, as needed
-Frequently check on progress of independent work

Career Readiness, Life Literacies, and Key Skills NJSLS

Please select all standards that apply to this unit of study:

- Act as a responsible and contributing community members and employee
- Attend to financial well-being
- Consider the environmental, social and economic impacts of decisions
- Demonstrate creativity and innovation
- Utilize critical thinking to make sense of problems and persevere in solving them
- Model integrity, ethical leadership and effective management
- Plan education and career paths aligned to personal goals
- Use technology to enhance productivity increase collaboration and communicate effectively
- Work productively in teams while using cultural/global competence

Suggestions on integrating these standards can be found at: https://www.nj.gov/education/standards/clicks/

Unit 2	
Degree Two: Quadratics	
Summary and Rationale	
Students will begin this unit with factoring polynomial expressions. They will then use factoring and learn other methods to solve quadratic equations. Students will learn the characteristics of quadratic equations as they graph them on a coordinate plane and use the graph to determine exact solutions or types of solutions. Students will learn different solving and graphing methods, as well as how to write and obtain important information from quadratic equations in different forms. During this unit, it is critical for students to see the relationship between the *solutions* of a quadratic equation, the *zeros* of the related quadratic function, and the *x-intercept* of this function's graph. They will also use quadratic equations and functions to model and represent real- world situations.	
Recommended Pacing	
October- January	
Standards	
Number and Quantity	
N.Q.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
N.CN.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.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
N.CN.3	Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

N.CN.5	Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.
N.CN.7	Solve quadratic equations with real coefficients that have complex solutions
N.CN.8	Extend polynomial identities to the complex numbers
N.CN.9	Know the fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
Algebra	
A.SSE.1	Interpret expressions that represent a quantity in terms of its context. k. Interpret parts of an expression, such as terms, factors, and coefficients. l. Interpret complication expressions by viewing one or more of their parts as a single entity.
A.SSE.2	Use the structure of an expression to identify ways to rewrite it.
A-SSE-3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. d. Factor a quadratic expression to reveal the zeros of the function it defines. e. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. F. Use the properties of exponents to transform expressions for exponential functions.
A-CED-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.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A-CED-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.
A-REI-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-4	Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equations in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula

	from this form. 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 equations. Recognize when the quadratic formula gives complex solutions and write them as a + bi and a – bi for real numbers a and b.
A-REI-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-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.
Functions	
F.IF.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.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.4	For a function that models relationships 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.5	Relate domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
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. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Write exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showering period, midline, and amplitude.
F-IF-8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the functions.

	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. Use the properties of exponents to interpret expressions for exponential functions.
F-IF-9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
F-BF-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
Geometry	
G.CO.2	Represent transformations in the plane, describe transformations as functions that take points in the plane as inputs and give other points at outputs.Compare transformations that preserve distance and angle to those that do not (e.g. translation vs. horizontal stretch)
Interdisciplinary Connections	
RL.10	Read and comprehend complex literary and informational texts independently and proficiently.
W.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
9.1	All students will demonstrate the creative, critical thinking, collaboration, and problem solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.
Integration of Technology	
8.1.8.A.5	Select and use appropriate tools and digital resources to accomplish a variety of tasks and to solve problems.
Career Readiness, Life Literacies and Key Skills	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.4	Evaluate different careers and develop various plans.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities.
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.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of a collaborative environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
All equations (and functions) of degree one or higher are defined as polynomial equations. Linear equations are degree one, so most yield at most one real solution. Quadratics equations are degree two equations therefore yield at most two real solutions. Quadratic equations contain an x^2 term. Since the opposite of squaring a number is taking the square root, this is the simplest method for solving a quadratic equation. However, not all quadratic equations can be solved by taking the square root of both sides. A second methods for solving quadratic equations is The Zero-Product Property (used with factoring methods) Many quadratic equations by factoring involve trinomials that can be factored to equivalent forms which are the product of two binomials. Factoring such a trinomial reverses the multiplication process. To factor a quadratic trinomial means to use the Properties of Real Numbers to rewrite it as a product of factors. Completely factoring a quadratic can involve one or more of the following methods and strategies: factoring out the GCF (greatest common factor), factoring by grouping (commonly used when breaking up the middle term of a trinomial into two terms, resulting in four terms), the "unfoil" or "sum/product" method, and special product or sum and difference of square patterns (used for special binomials).	What are the characteristics of quadratic equations? (or functions)? How can you solve a quadratic equation algebraically? By graphing? What is the reason for having the different methods for solving quadratic equations and when can using one method be necessary or more appropriate than another? How do the results of operations on real numbers differ when applied to the complex numbers? What does the equation and graph of a quadratic function look like? How does using the different forms of a quadratic function yield characteristics that help us graph?

If a quadratic trinomial has four or more terms, it may be possible to group the terms and factor binomials from the groups. This method is called "Factor by Grouping."

The signs and factors of the coefficients of a trinomial can be used to indicate how the trinomial can be factored.

To factor a trinomial means to "undistributed" or "unfoil" so that it is written as a product of two binomials (factored form). The sum/product method is the most efficient method when factoring the simplest trinomials of the form: $ax^2 + bx + c$ and $a = 1$. When a does not equal one, the sum/product method can still be used in combination with the factoring by grouping method.

Some quadratic trinomials that are the squares of binomials, or binomials that are the differences of two squares, can be factored by reversing the rules for multiplying binomials that contain special product patterns.

The following is a step-by-step factoring strategy that can be used for factoring all quadratics:

1) Factor out the greatest common factor, if one exists. (GCF).
2) Does it contain four terms? Try factor by grouping method.
3) Trinomial? (three terms) Does a = 1? If so, "Unfoil" using sum/product method.

If a ≠ 1, Use sum/product method with factor by grouping method. (Break up the middle term so that there are four terms.)

4) Binomial? Look for Difference of Squares, Sum or Difference of Cubes

Reminder: A sum of squares cannot be factored. (prime)

5) Repeat steps until all factors are prime.

A third method for solving quadratic equations is using The Quadratic Formula. Any quadratic equation can be solved using The Quadratic Formula.

When solving quadratic equations, one particular method for solving may be more appropriate or necessary over another. The best method to use depends on the forms of the given equations, the types of solutions that exist, and how precise the solutions should be. The value of the discriminant, $b^2 - 4ac$, of a quadratic equation can be

How can you solve quadratic inequalities algebraically? By graphing?

What are the connections between the algebraic and graphical representations of both one-variable and two variable quadratic inequalities?

How can you use quadratic equations, functions, and inequalities to model real-world situations?

used to determine the number and type of solutions and can also help predict the best solving method. Sind quadratic equations are of degree two, they have two solutions that can be determined from a graph (The solutions are the x-intercepts.), or by using different algebraic methods. Four algebraic methods are factoring, taking the square root of both sides, completing the square, or using the Quadratic Formula. The best method to use depends on the forms and characteristics of the given equations, the nature of the solutions, and how precise the solutions should be. Quadratics can have real number solutions, but can also have solutions in a larger system, called the complex numbers. There are differences between the results of operations on complex numbers from those obtained within the real number system. A function is a relationship in which one set of values defines another. All functions can be used to model many important phenomena. A function is a relationship between variables in which each value of the input variable (value in the domain) is associated with a unique value of the output variable (value in the range.) In order to determine if an equation or a set of ordered pairs represents a function, the solutions of the equation or the ordered pairs can be organized in a table or plotted on a graph. If the table of values shows that each value in one set is paired with exactly one value in the other set, the relation is a function. The vertical line test uses the graph to determine whether a relation is a function. Determining an output value of a function, given an input value, requires evaluating the algebraic expression that is being used to represent the function. Functions can be represented using an equation, or through a graph of the ordered pairs on a coordinate plane that satisfy the equation. The graph of a function is a useful way of visualizing the relationship of the function, as well as its complete domain and range. Unlike linear functions, the family of quadratic functions models certain situations where the rate of change is not constant	

Quadratic functions are graphed by a symmetric u-shaped graph called a parabola. The equation of a parabola written in standard form is $y = ax^2 + bx + c$. The equation can be used to find the coordinates of the vertex. The value of b translates the position of the axis of symmetry and the vertex of the parabola. A table of values can be used to find points to the left and right of the vertex to form its u-shape. Graphing a quadratic function provides another method for solving quadratic equations. The x-intercepts of the function are the solutions to the related quadratic equation. A parabola will cross the x-axis at most two times.

The *solutions* of a quadratic equation $ax^2 + bx + c = 0$ are equal to the *real zeros* of the related quadratic function $y = ax^2 + bx + c$, and the *x-intercepts* of this function's graph. Zeros that are not real are not visible on the graph of a function in a coordinate plane of real numbers.

Quadratic inequalities can be one variable or two, and both types can be solved and represented algebraically and graphically.

Many real world mathematical problems can be modeled and represented algebraically and graphically by quadratic equations, functions, and inequalities. A function that models a real world situation can be represented using an equation or graph that can be used to make estimates or predictions about future occurrences. A real-world graph of a function should only show points that make sense in the given situation.

Evidence of Learning (Assessments)

Tests
Quizzes
Homework
Class participation

Objectives (SLO)

Students will know:	Students will be able to:
· Quadratic equations · Solutions · Graphing/x-intercepts/zeros/roots Factoring · The Quadratic Formula	-Factor quadratic trinomials -Factor perfect-square trinomials and the difference of two squares -Find the roots of a quadratic equation by factoring.

· Quadratic Functions Parabola · Vertex · Axis of Symmetry Quadratics Inequalities	- Solve quadratic equations by taking the square root of both sides. - Perform operations on complex numbers. - Solve quadratic equations by completing the square. - Use completing the square to write quadratic functions in vertex form $y = a(x - h)^2 + k$. Solve quadratic equations using the quadratic formula. - Find the discriminant of a quadratic equation and use the value to describe the nature of the solutions and to choose the best method for solving. - Write and graph quadratic functions in standard form ($y = ax^2 + bx + c$), vertex form ($y = a(x - h)^2 + k$), and intercept form ($y = a(x - p)(x - q)$). - Solve quadratic inequalities in one variable by graphing and algebraically. - Find the vertex, axis of symmetry, domain and range, x and y intercepts of quadratic functions. - Graph Quadratic functions in standard form, vertex form, and intercept form. - Solve quadratic inequalities in one variable by graphing and algebraically. - Graph quadratic inequalities in two variables to show all solutions. - Use quadratic equations, inequalities, and functions to model and solve real-life problems.

Suggested Resources/Technology Tools

-Textbooks, workbooks, and assessment aides
-Online textbook
-NJSLA Practice Tests and Released Items
-Khan Academy; www.insidemathematics.org/performanceassessment-tasks
-Calculators when specified

-Google Classroom
-Desmos graphing calculator
-Kuta Software

Tier 1 Modifications and Accommodations

Including special education students, Multilingual Language Learners (MLLs), students at risk of school failure, gifted and talented students, and students with 504 plans;

General Modifications for students struggling to learn:
Small group instruction within the classroom
Differentiation through content, process, product,and environment
Individual feedback and praise towards what is done correctly based upon effort, attitude and strategy.
Help students manage individual stressors for the student and plan alternate pathways for completion of assignments.

Special Education:
Modifications are determined by each student's Individual Education Plan. Examples include:
-Use concrete examples of concepts before teaching the abstract
-Reduce the number of concepts presented at one time
-Give additional presentations by varying the methods using repetition, simpler explanations, more examples and modeling
-Use of aids (calculator, computer, etc.)
-Frequently check on progress of independent work
-Provide study guides and copy of notes
-Provide repetition and practice

MLL:
Modifications are determined by each student. Examples include:
- Provide students with notes, examples, tests, and quizzes in their primary language
- Monitor the student's comprehension of language used during instruction
- Give written directions to supplement verbal directions
- Frequently check on progress of independent work

504:
Modifications are determined by each student's 504 plan. Examples include:
-Teacher will review, restate and repeat directions, as needed
-Frequently check on progress of independent work

Career Readiness, Life Literacies, and Key Skills NJSLS

Please select all standards that apply to this unit of study:

Act as a responsible and contributing community members and employee
Attend to financial well-being
Consider the environmental, social and economic impacts of decisions
Demonstrate creativity and innovation

Utilize critical thinking to make sense of problems and persevere in solving them
Model integrity, ethical leadership and effective management
Plan education and career paths aligned to personal goals
Use technology to enhance productivity increase collaboration and communicate effectively
Work productively in teams while using cultural/global competence

Suggestions on integrating these standards can be found at: https://www.nj.gov/education/standards/clicks/

Unit 3

Polynomials

Summary and Rationale

Students will first use the Properties of Exponents to simplify and perform operations involving powers, monomials and polynomials.

Students will utilize and extend factoring techniques to solve polynomial equations of degree higher than two. They will use the Properties of Real Numbers and Exponents, particularly the Commutative and Associative Properties and the Distributive Property to manipulate polynomial expressions, and multiply and factor polynomials.

Students will then thoroughly analyze the characteristics and properties of polynomial equations, their related functions, and graphs. Students will learn different solving and graphing methods, as well as how to write and obtain important information from polynomial equations of degree greater than two in different forms. As with linear and quadratic functions it is crucial for students to revisit the relationship between the *solutions* of a polynomial equation, the *zeros* of a polynomial function, and the *x-intercept* of this function's graph.

Recommended Pacing

February- April

Standards

Number and Quantity	
N.CN.8	Extend polynomial identities to the complex numbers.
N.CN.9	Know the fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
Algebra	

A-SSE-1	Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. f. Interpret complication expressions by viewing one or more of their parts as a single entity.
A-SSE-2	Use the structure of an expression to identify ways to rewrite it.
A-APR-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.2	Know and apply the remainder Theorem: For a polynomial p(x) and a number a, the remainder of division by x – a is p(a) = 0 if and only if (x – a) is a factor of p (x)
A.APR.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 polynomials.
A.APR.4	Prove polynomial identities and use them to describe numerical relationships.
A.REI.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.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.
Functions	
F-IF-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-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-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-5	Relate domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
F-IF-6	Calculate and interpret the average rate of change of a function over a specified interval. Estimate the rate of change from a graph.

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. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Write exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showering period, midline, and amplitude
F-IF-8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the functions. 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. Use the properties of exponents to interpret expressions for exponential functions.
F-IF-9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
F.BF.1	Write a function that describes a relationship between two quantities. d. Determine an explicit expression, a recursive process, or steps for calculation from a context. e. Combine standard functions types using arithmetic operations. d. Compose functions
F.BF.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.
Geometry	
G.CO.2	Represent transformations in the plane, describe transformations as functions that take points in the plane as inputs and give other points at outputs.Compare transformations that preserve distance and angle to those that do not (e.g. translation vs. horizontal stretch)
Interdisciplinary Connections	
RL.10	Read and comprehend complex literary and informational texts independently and proficiently.
W.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

9.1	All students will demonstrate the creative, critical thinking, collaboration, and problem solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.
Integration of Technology	
8.1.8.A.5	Select and use appropriate tools and digital resources to accomplish a variety of tasks and to solve problems.
Career Readiness, Life Literacies and Key Skills	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.4	Evaluate different careers and develop various plans.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities.
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.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of a collaborative environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
The Properties of Exponents make it easier to simplify products or quotients of powers with the same base or powers raised to a power or products raised to a power.	How can you simplify expressions involving exponents? How do you know when an expression with exponents is completely simplified?

To multiply powers with the same base, add the exponents. To raise a power to a power, multiply the exponents. To raise a product to a power, raise each factor to the power and multiply. To divide powers with the same base, subtract the exponents. To raise a quotient to a power, raise the numerator and the denominator to the power and simplify. A monomial is a number, a variable, or the product of a number and one or more variables with whole number exponents. The degree of a monomial is the sum of the exponents of the variables in the monomial. Monomials can be used to form larger expressions called polynomials. A polynomial is a monomial or a sum of monomials. A polynomial of two terms is a binomial. A polynomial of three terms is a trinomial. A polynomial is usually written in standard form, which means that the terms are arranged in decreasing order, from largest exponent to smallest exponent. The degree of a polynomial in one variable is the largest exponent of that variable. Polynomials can be added and subtracted. To add or subtract polynomials, add or subtract like terms. The Properties of Real Numbers can be used to multiply a monomial by a polynomial or to simplify the product of binomials. To multiply polynomials, use The Distributive Property or FOIL pattern. Simplify by using the Multiplication Properties of Exponents and then combining like terms. Special product patterns occur when multiplying polynomials, particularly when multiplying two binomials. These patterns include the Sum and Difference Patterns and the Square of a Binomial Pattern. One important fact is that with exception to the Sum and Difference Patterns, when you multiply two binomials, the result is a trinomial. Performing operations on polynomial expressions requires the accurate application of the properties of exponents and the order of operations, as well as the ability to distinguish between like and unlike terms. The requirements for and the results of addition and subtraction of polynomials differ greatly from those involving multiplication, division, and powers.	What are the requirements for the addition and subtraction of monomials and polynomials? Are these the same for multiplication and division? How do the results of the operations differ? How are the properties of real numbers related to polynomials? How do you add, subtract, and multiply polynomials? How do you factor polynomials? What steps should be taken when factoring a polynomial expression or equation? What specifics do you look for and how do you know when it is completely factored? How do you solve a polynomial equation? What characteristics, other than its solutions, of a polynomial equation can be used to describe the behavior and sketch the graph of its related function? What theorems and methods are used to identify the total number of roots and determine the real zeros of a polynomial function? Which types of roots are seen on the graph of a polynomial function? Which are not visible? What happens in the graph if there is a double root?

Some trinomials and some polynomials of a degree greater than two can be factored to equivalent forms which are the product of two binomials. Factoring a polynomial reverses the multiplication process. To factor a polynomial means to use the Properties of Real Numbers to rewrite it as a product of factors. Completely factoring a polynomials can involve one or more of the following methods and strategies: factoring out the GCF (greatest common factor), factoring by grouping (commonly used when factoring polynomials with four terms), the "unfoil" or "sum/product" method (commonly used for factoring trinomials), and special product or sum and difference of cube patterns (used for special binomials).

If a polynomial has four or more terms, it may be possible to group the terms and factor binomials from the groups. This method is called "Factor by Grouping."

The signs and factors of the coefficients of a trinomial can be used to indicate how the trinomial can be factored. To factor a trinomial means to "undistributed" or "unfoil" so that it is written as a product of two binomials (factored form). The sum/product method is the most efficient method when factoring the simplest trinomials of the form: $ax^2 + bx + c$ and $a = 1$. When a does not equal one, the sum/product method can still be used in combination with the factoring by grouping method.

Some polynomials, such as trinomials that are the squares of binomials, or binomials that are the differences of two squares, can be factored by reversing the rules for multiplying binomials that contain special product patterns.

The following is a step-by-step factoring strategy that can be used for factoring all polynomials:

1) Factor out the greatest common factor, if one exists. (GCF).
2) Does it contain four terms? Try factor by grouping method.
3) Trinomial? (three terms) Does a = 1? If so, "Unfoil" using sum/product method.

If $a \neq 1$, Use sum/product method with factor by grouping method. (Break up the middle term so that there are four terms.)

4) Binomial? Look for Difference of Squares, Sum or Difference of Cubes

Reminder: A sum of squares cannot be factored. (prime)

5) Repeat steps until all factors are prime.

All equations of degree one or higher are defined as polynomial equations. The Fundamental Theorem of Algebra states that the number of solutions to a one-variable polynomial equation is equal to the degree of the polynomial. These solutions can be determined through graphing (The solutions are the x-intercepts.) and using one more previously learned and new algebraic methods and theorems. The best method(s) to use depends on the forms and characteristics of the given equations, the nature of the solutions, and how precise the solutions should be. Polynomials can have real number solutions, but can also have solutions in a larger system, called the complex numbers. There are differences between the results of operations on complex numbers from those obtained within the real number system. A function is a relationship in which one set of values defines another. All functions can be used to model many important phenomena. A function is a relationship between variables in which each value of the input variable (value in the domain) is associated with a unique value of the output variable (value in the range.) In order to determine if an equation or a set of ordered pairs represents a function, the solutions of the equation or the ordered pairs can be organized in a table or plotted on a graph. If the table of values shows that each value in one set is paired with exactly one value in the other set, the relation is a function. The vertical line test uses the graph to determine whether a relation is a function. Determining an output value of a function, given an input value, requires evaluating the algebraic expression that is being used to represent the function. Functions can be represented using an equation, or through a graph of the ordered pairs on a coordinate plane that satisfy the equation. The graph of a function is a useful way of visualizing the relationship of the function, as well as its complete domain and range. The graphs of polynomial functions in a coordinate plane vary, yet yield various patterns. Using algebraic methods to manipulate and/or solve the equation of a polynomial function can throw light on the function's properties and help visualize the behavior of its graph,	

which can result in the use of more effective and efficient graphing methods. The *solutions* of a polynomial equation are equal to the *real zeros* of the related polynomial function and the *x-intercepts* of this function's graph. Zeros that are not real are not visible on the graph of a function in a coordinate plane of real numbers.	
Evidence of Learning (Assessments)	
Tests Quizzes Homework Class participation	
Objectives (SLO)	
Students will know: · Exponents · Monomials · Polynomials · Trinomials · Distributive Property · Fundamental Theorem of Algebra · Rational Zero Theorem · Graphing	Students will be able to: --Find the GCF of monomials -Factor polynomials by using the greatest common factor -Factor polynomials by grouping - Evaluate and simplify expressions containing the laws of exponents. - Classify polynomials - Add/subtract/multiply polynomials - Divide polynomials using long and synthetic division. - Evaluate a polynomial function by direct substitution and synthetic substitution. - Factor polynomial expressions of higher degree. - Factor difference and sum of cubes. - Use factoring methods to solve polynomial equations. - Relate the results of division to the solutions of a polynomial equation and to The Remainder and Factor Theorems. - Use the Fundamental Theorem of Algebra to determine the number of zeros of a polynomial function.

	- Use The Rational Zero Theorem to identify possible rational zeros of a polynomial function. - Use all of the above to identify all zeros of a polynomial function, real and imaginary, and to sketch a graph. - Use polynomial equations and functions to model and solve real-life problems.

Suggested Resources/Technology Tools

-Textbooks, workbooks, and assessment aides
-Online textbook
-NJSLA Practice Tests and Released Items
-Khan Academy; www.insidemathematics.org/performanceassessment-tasks
-Calculators when specified
-Google Classroom
-Desmos graphing calculator
-Kuta Software

Tier 1 Modifications and Accommodations

Including special education students, Multilingual Language Learners (MLLs), students at risk of school failure, gifted and talented students, and students with 504 plans;

General Modifications for students struggling to learn:
Small group instruction within the classroom
Differentiation through content, process, product,and environment
Individual feedback and praise towards what is done correctly based upon effort, attitude and strategy.
Help students manage individual stressors for the student and plan alternate pathways for completion of assignments.

Special Education:
Modifications are determined by each student's Individual Education Plan. Examples include:
-Use concrete examples of concepts before teaching the abstract
-Reduce the number of concepts presented at one time
-Give additional presentations by varying the methods using repetition, simpler explanations, more examples and modeling
-Use of aids (calculator, computer, etc.)
-Frequently check on progress of independent work
-Provide study guides and copy of notes
-Provide repetition and practice

MLL:

Modifications are determined by each student. Examples include:
- Provide students with notes, examples, tests, and quizzes in their primary language
- Monitor the student's comprehension of language used during instruction
- Give written directions to supplement verbal directions
- Frequently check on progress of independent work

504:
Modifications are determined by each student's 504 plan. Examples include:
-Teacher will review, restate and repeat directions, as needed
-Frequently check on progress of independent work

Career Readiness, Life Literacies, and Key Skills NJSLS

Please select all standards that apply to this unit of study:

Act as a responsible and contributing community members and employee
Attend to financial well-being
Consider the environmental, social and economic impacts of decisions
Demonstrate creativity and innovation
Utilize critical thinking to make sense of problems and persevere in solving them
Model integrity, ethical leadership and effective management
Plan education and career paths aligned to personal goals
Use technology to enhance productivity increase collaboration and communicate effectively
Work productively in teams while using cultural/global competence

Suggestions on integrating these standards can be found at: https://www.nj.gov/education/standards/clicks/

Unit 4	
Roots and Rational Exponents	
Summary and Rationale	
Students will extend the use of exponents to include zero, negative, and rational exponents. They will extend the familiar ideas of squares and square roots from Algebra 1 to other exponents and roots, including those that are *not* whole numbers in expressions. They will use the Properties of Exponents and Radicals to simplify and perform operations on expressions and solve equations containing these .The unit also extends the study of functions to square root and cube root functions.	
Recommended Pacing	
May- June	
Standards	
Number and Quantity	
N-RN-1	Explain how the definition of the meaning of rational exponents follows from extending properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
N-RN-2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
N-RN-3	Explain why the sum or product of two rational numbers is rational; that the sum of the rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
Algebra	
A-SSE-1	Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. f. Interpret complication expressions by viewing one or more of their parts as a single entity.

A-SSE-2	Use the structure of an expression to identify ways to rewrite it.
A.SSE.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
A-REI-2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
A.REI.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.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.
Functions	
F-IF-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-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-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-5	Relate domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
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. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Write exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showering period, midline, and amplitude
F-IF-8	Write a function defined by an expression in different but equivalent forms to reveal and

	explain different properties of the functions. 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. Use the properties of exponents to interpret expressions for exponential functions.
F-IF-9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
F.BF.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.
Geometry	
G.CO.2	Represent transformations in the plane, describe transformations as functions that take points in the plane as inputs and give other points at outputs.Compare transformations that preserve distance and angle to those that do not (e.g. translation vs. horizontal stretch)
Interdisciplinary Connections	
RL.10	Read and comprehend complex literary and informational texts independently and proficiently.
W.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
9.1	All students will demonstrate the creative, critical thinking, collaboration, and problem solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures.
Integration of Technology	
8.1.8.A.5	Select and use appropriate tools and digital resources to accomplish a variety of tasks and to solve problems.
Career Readiness, Life Literacies and Key Skills	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.4	Evaluate different careers and develop various plans.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities.
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.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of a collaborative environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
An algebraic expression that contains a radical is called a radical expression. Radical expressions can be rewritten using rational exponents and vice versa. The Properties of Exponents apply to all rational exponents. The use of inverse operations and the properties of equality can be applied to the solving of radical equations and equations with rational exponents. However, certain procedures may lead to invalid solutions called extraneous solutions (or roots). A function is a relationship in which one set of values defines another. All functions can be used to model many important phenomena. Determining an output value of a function, given an input value, requires evaluating the algebraic expression that is being used to represent the function.	How do you rewrite a radical or root expression using rational exponents? How do you simplify a radical expression (or an expression with rational exponents) ? How can you simplify expressions involving rational exponents? How can you solve radical equations or equations with rational exponents? When and how do you check for extraneous solutions when solving equations containing radicals and rational exponents? What does the graph of a square root function look like? Cube root function? How do they differ?

Functions can be represented using an equation, or through a graph of the ordered pairs on a coordinate plane that satisfy the equation. The graph of a function is a useful way of visualizing the relationship of the function, as well as its complete domain and range. The graphs of radical functions such as those involving square and cube roots in a coordinate plane vary, yet yield various patterns.	

Evidence of Learning (Assessments)

Tests
Quizzes
Homework
Class participation

Objectives (SLO)

Students will know: · Exponents · Radicals · Roots	Students will be able to: -Evaluate *n*th roots of real numbers using both radical and rational exponent notation. -Evaluate and simplify expressions containing rational exponents -Apply the properties of exponents to simplify and evaluate expressions containing rational exponents. -Graph square root and cube root functions. -Solve equations that contain rational exponents and radicals.

Suggested Resources/Technology Tools

-Textbooks, workbooks, and assessment aides
-Online textbook
-NJSLA Practice Tests and Released Items
-Khan Academy; www.insidemathematics.org/performanceassessment-tasks
-Calculators when specified
-Google Classroom
-Desmos graphing calculator
-Kuta Software

Tier 1 Modifications and Accommodations

Including special education students, Multilingual Language Learners (MLLs), students at risk of school failure, gifted and talented students, and students with 504 plans;

General Modifications for students struggling to learn:
Small group instruction within the classroom
Differentiation through content, process, product,and environment
Individual feedback and praise towards what is done correctly based upon effort, attitude and strategy.
Help students manage individual stressors for the student and plan alternate pathways for completion of assignments.

Special Education:
Modifications are determined by each student's Individual Education Plan. Examples include:
-Use concrete examples of concepts before teaching the abstract
-Reduce the number of concepts presented at one time
-Give additional presentations by varying the methods using repetition, simpler explanations, more examples and modeling
-Use of aids (calculator, computer etc.)
-Frequently check on progress of independent work
-Provide study guides and copy of notes
-Provide repetition and practice

MLL:
Modifications are determined by each student. Examples include:
- Provide students with notes, examples, tests, and quizzes in their primary language
- Monitor the student's comprehension of language used during instruction
- Give written directions to supplement verbal directions
- Frequently check on progress of independent work

504:
Modifications are determined by each student's 504 plan. Examples include:
-Teacher will review, restate and repeat directions, as needed
-Frequently check on progress of independent work

Career Readiness, Life Literacies, and Key Skills NJSLS

Please select all standards that apply to this unit of study:

Act as a responsible and contributing community members and employee
Attend to financial well-being
Consider the environmental, social and economic impacts of decisions
Demonstrate creativity and innovation
Utilize critical thinking to make sense of problems and persevere in solving them
Model integrity, ethical leadership and effective management
Plan education and career paths aligned to personal goals
Use technology to enhance productivity increase collaboration and communicate effectively
Work productively in teams while using cultural/global competence

Suggestions on integrating these standards can be found at: https://www.nj.gov/education/standards/clicks/