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<th>Course: Algebra II CP</th>
<th>Subject Area: Mathematics</th>
<th>Grade Level: 9-11</th>
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<td><strong>Unit 1:</strong> Linear Equations and Inequalities (20 Days)</td>
<td><strong>Unit 2:</strong> Linear Equations and Functions (27 Days)</td>
<td><strong>Unit 3:</strong> Systems of Linear Equations and Inequalities/Use of Matrices (16 Days)</td>
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**Enduring Understandings**
1. Algebra can be used to communicate information in symbolic and simplified forms.
2. Order and rules are extremely important for communication.
3. The Algebraic Solving Process is an excellent guideline for all types of solving strategies (Verbal, Label, Algebraic Model, Solve, Answer).
4. All the facts of arithmetic and algebra follow from certain properties.
5. Just as you use properties of equality to solve equations, you can use properties of inequality to solve inequalities.
6. A function is a special type of relation when the input value is mapped to one and only one output value which can be viewed in a table or a graph.
7. If you move from any point on a line in the coordinate plane to any other point on the line, the ratio of the vertical change to the horizontal change is constant. That constant rate describes the slope of the line.
8. The slopes of two lines indicate how the lines are related (parallel or perpendicular).
9. Functions can be expressed in different ways including equations, graphs, tables or multiple functions.
10. We do not always connect the points on a graph.

**Essential Questions**
1. Why is order so important?
2. What is the value of studying the properties of real numbers?
3. Why is creating a strategy helpful?
4. Why do you need to know mathematical vocabulary?
5. Why is it important to label and model real-life situations?
6. When is a problem answered?
7. Why must mathematical vocabulary be precise?
8. How can functions be interpreted?
9. Can all relationships be transferred into functions?
10. Does it matter which form of a linear equation you use?
11. What is the most useful representation of a function – equation, table, or graph?
12. How does the rate of change impact a function?

1. To solve a system of equations, find a set of values that replace the variables in the equations and make each equation true.
2. The point where the lines of the equations intersect on a graph is the solution.
3. A matrix can be used to represent and efficiently solve a system of equations.
4. How can decisions be made using linear systems?
5. How can the solution be determined?
6. How do the solutions for systems of linear equations and inequalities compare and contrast?
7. How can data be organized and utilized?
| **Content Knowledge** | 1. How to use properties of real numbers to solve linear equations and inequalities.  
2. Recognize and develop strategies to create algebraic model to solve problems.  
2. Sometimes no value of the variable makes the equation or inequality true.  
3. Sometimes all values of the variable make the equation or inequality true (Identities).  
4. The relationship between the algebraic and graphing representations of inequalities. | 1. The characteristics and representations of a function  
2. How to use the slope, y intercept, or points of a line to write the equation of that line.  
3. The relationship between parallel and perpendicular lines.  
4. How to determine slope given different information.  
5. Use the relationship between slope and rate of change to interpret functions and write the equations.  
6. Plot a scatter plot, determine a line of best fit and write the equation of that line to make predictions.  
7. Graph linear inequalities in two variables and determine the solution from the intersection.  
8. Graphing absolute value functions.  
9. How to identify and use Arithmetic sequences and series. | 1. How to graph each equation and identify if there is no solution (parallel), one solution (intersecting), or infinitely many solutions (coinciding) using slope and y intercept.  
2. How to use the method of graphing to solve the system.  
3. How to use the method of substitution to solve the system when it is easy to isolate one of the variables in two or three variables.  
4. How to use the method of elimination to solve the system when it is easy to write equivalent systems in two or three variables.  
5. How to create an algebraic model to solve applications using systems of equations.  
5. How to use a graphing calculator to solve a system using matrices |
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<td><strong>PERFORMANCE TASK(S):</strong></td>
<td>1.Graded HW: Quiz 1,2,3</td>
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<td>2.Kahoot- Linear Inequalities</td>
<td>2.Flipped classroom: graph to use data to draw a scatter plot, find a line of best fit to predict future data.</td>
<td>2.Discovery graphing activity: Graphing lines on the same grid.</td>
<td>2.Flipped classroom: Graph systems of nonlinear and linear functions using Desmos, determine solutions and create ways to solve algebraically.</td>
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<td><strong>OTHER EVIDENCE:</strong></td>
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<td>1.Student self evaluation 1-3-5. Hold up number of fingers that corresponds to understanding.</td>
<td>2.Graded assessment to complete a square in Desmos using piecewise functions</td>
<td>3.Group work to allow teacher to assist learning and evaluate understanding.</td>
<td>4.Extension: Systems of Linear inequalities Using Desmos calculator</td>
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<td>2.Group work on 1.1-4 to review Algebra</td>
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<td>2.Opening and closing activities.</td>
<td>5.Flipped Classroom: Graph systems of nonlinear and linear functions using Desmos, determine solutions and create ways to solve algebraically.</td>
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<td>1. Teacher circulates around room to answer questions and evaluate understanding.</td>
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<td>3.Daily student self evaluation indicating understanding of material. 1-3-5.</td>
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<tr>
<td>3Partner work on 1.5 applications and strategies. Teacher circulates around room to answer questions and evaluate understanding.</td>
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<td>4.Opening and closing activities</td>
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<td><strong>6. Calculating slope and understanding the relationship between slope and rate of change</strong></td>
<td>7.Writing equations of lines given various pieces of information.</td>
<td>8.Creating equations that describe numbers or relationships.</td>
<td>9.Determining correlation and finding a line of best fit and its equation.</td>
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<td>10.Creating algebraic models and solving for piecewise, linear and absolute value functions.</td>
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<td>10.Creating algebraic models and solving for piecewise, linear and absolute value functions.</td>
<td>11. Creating algebraic models and solving for piecewise, linear and absolute value functions.</td>
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<td><strong>linear equations (using technology for matrices of dimension 3 x 3 or greater).</strong></td>
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<td>4.Solve a simple system consisting of a linear equation and a quadratic equation in two variables.</td>
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**SEL Competencies**

**NJSLS Standards**

**Priority Standards:**

**N-Q:1,2**
- A. Reason quantitatively and use units to solve problems.
  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.
  2. Define appropriate quantities for the purpose of descriptive modeling

**A-CED:1,4**
- A. Create equations that describe numbers or relationships
  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.
  2. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For

**Priority Standards:**

**N-Q:1**
- A. Reason quantitatively and use units to solve problems.
  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.

**A-CED:2**
- A. Create equations that describe numbers or relationships
  1. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
  2. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

**A-REI:10,12**
- D. Represent and solve equations and inequalities graphically
  10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate
(example, rearrange Ohm’s law $V = IR$ to highlight resistance $R$.

A-REI: 1, 2, 3
Understand solving equations as a process of reasoning and explain the reasoning
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.
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

A-SSE: 1, 2
A. Interpret the structure of expressions
1. Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of $P$ and a factor not depending on $P$
2. Use the structure of an expression to identify ways to rewrite it. For example, see $x^2 - y^2$ as $(x^2 - y^2)$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

plane, often forming a curve (which could be a line).
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.

F-IF: 1-7
A. Understand the concept of a function and use function notation
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 $y = f(x)$.
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.
B. Interpret functions that arise in applications in terms of the context
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.
5. Interpret the structure of expressions that represent a quantity in terms of its context.
6. Reason quantitatively and use units to solve problems.
7. Perform operations on matrices and use matrices in applications 7.
8. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
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 $3 \times 3$ or greater).

Support Standards:
NJSLSA.R4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
N-Q: 1
A. Reason quantitatively and use units to solve problems.
C. Perform operations on matrices and use matrices in applications 7.
8. (+) Add, subtract, and multiply matrices of appropriate dimensions
8.1.2.D.4 Research and understand the positive and negative impact of one’s digital footprint.
B. Write expressions in equivalent forms to solve problems  
   A-APR,6
D. Rewrite rational expressions  
6. Rewrite simple rational expressions in different forms; write \( \frac{a(x)}{b(x)} \) in the form \( q(x) + \frac{r(x)}{b(x)} \), where \( a(x) \), \( b(x) \), \( q(x) \), and \( r(x) \) are polynomials with the degree of \( r(x) \) less than the degree of \( b(x) \), using inspection, long division, or, for the more complicated examples, a computer algebra system.

Support Standards:
- SEL Competencies

NJSLSA.R4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
F-LE,5
B. Interpret expressions for functions in terms of the situation they model
5. Interpret the parameters in a linear or exponential function in terms of a context.
8.1.12.D.4 Research and understand the positive and negative impact of one’s digital footprint.
8.1.12.D.5 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
9.2.12.C.1 Review career goals and determine steps necessary for attainment.
9.2.12.C.3 Identify transferable career skills and design alternate career plans

CRP Standards:
CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.

| Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. |
| 5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function \( h(n) \) gives the number of person-hours it takes to assemble \( n \) engines in a factory, then the positive integers would be an appropriate domain for the function. |
| 6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. |
| C. Analyze functions using different representations 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 piecewise-defined functions, including step functions and absolute value functions. |

8.1.12.D.5 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
9.2.12.C.1 Review career goals and determine steps necessary for attainment.
9.2.12.C.3 Identify transferable career skills and design alternate career plans

Support Standards:
NJSLSA.R4. Interpret words and phrases as they are used in a text, including...
| their impact on educational, career, personal and or social needs. | determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. |
| 9.2.12.C.1 Review career goals and determine steps necessary for attainment. | F-LE:2 |
| 9.2.12.C.3 Identify transferable career skills and design alternate career plans | A. Construct and compare linear and exponential models and solve problems. |
| CRP Standards: | 2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). |

| CRP1. Act as a responsible and contributing citizen and employee. | 8.1.12.D.4 Research and understand the positive and negative impact of one’s digital footprint. |
| CRP2. Apply appropriate academic and technical skills. | 8.1.12.D.5 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs. |
| CRP4. Communicate clearly and effectively and with reason. | 8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs. |
| CRP11. Use technology to enhance productivity. | 9.2.12.C.1 Review career goals and determine steps necessary for attainment. |
| CRP12. Work productively in teams while using cultural global competence. | 9.2.12.C.3 Identify transferable career skills and design alternate career plans |

**CRP Standards:**
- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
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<td><strong>Unit 4:</strong> Quadratic Functions (27 Days)</td>
<td><strong>Unit 5:</strong> Polynomials and Polynomial Functions (31 Days)</td>
<td><strong>Unit 6:</strong> Powers Roots and Radicals (24 Days)</td>
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</table>
| **Enduring Understandings** | 1. The graph of any quadratic function is a transformation of the graph of the parent quadratic function, \( y = x^2 \).  
2. The zeros of quadratic functions are equivalent to the x-intercepts of the graph of the function or the solutions of the quadratic equation.  
3. Quadratic Functions can be solved using various methods.  
4. Quadratic functions can be solved in the real or complex number systems. | 1. The properties of exponents allow us to simplify expressions that involve exponents.  
2. Most problems can be solved in different ways.  
3. Word problems and graphs are tools that can help us make a meaningful connections solve real-world problems.  
4. Equations and operations can help us make sense of various solutions. | 1. Every function has an inverse.  
2. A function and its inverse reverse the roles of the domain and range values.  
3. Radicals are real numbers and the same rules that apply to real numbers, apply to radicals.  
4. A function can be restricted by a domain and range and this can be seen in the graph.  
5. Real world applications are usually restricted to the first quadrant. |
| **Essential Questions** | 1. How can decisions be made using quadratic functions?  
2. How are the real solutions of a quadratic equation related to its graph?  
3. Which is the best method for solving quadratic equations – graphing, factoring, completing the square, or the quadratic formula? | 1. What does the degree of the polynomial tell you about its related polynomial functions?  
2. For a polynomial function, how are the factors, zeros, and x intercepts related?  
3. For a polynomial equation, how are the factors and roots related? | 1. How do we find nth roots?  
2. Do we apply properties of exponents differently if the exponents are non-integer rationals?  
3. Can we apply operations to functions? If so, what procedures do we follow? |
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<th>Content Knowledge</th>
<th>Major Skills</th>
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| 1. How to identify the axis of symmetry, vertex, y-intercept, and maximum/minimum from Standard Form and Vertex Form  
2. How to factor a quadratic expression to reveal the zeros of the function it defines.  
3. How to translate between factored form and standard form  
4. How to solve quadratics (identify its zeros) by graphing, factoring, completing the square, taking the square root and using the quadratic formula.  
5. How to find complex solutions and write them in the form a + bi where a and b are real numbers.  
6. How to graph a quadratic function and interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include zeros; intercepts; relative maximums and minimums; symmetries; and end behavior. | 1. Performing arithmetic operations with complex numbers.  
2. Use complex numbers in polynomial identities and equations.  
3. Solve quadratic equations with real coefficients that have complex solutions.  
4. Interpret parts of an expression, such as terms, factors, and coefficients and use the structure of an expression to identify ways to rewrite it.  
5. Choose and produce an equivalent form of an expression. |
| 4. What is end behavior and how do we find it?  
1. How to interpret imaginary numbers  
2. How to solve various polynomial equations various ways  
3. How to add, subtract, multiply and divide polynomial expressions and to simplify.  
4. How to determine the number of solutions  
5. How to transform an expression in different forms.  
6. Key features of polynomial graphs.  
7. How to solve real world problems. | 1. Performing computations with polynomials and imaginary numbers.  
2. Classifying polynomials by degree.  
3. Factoring polynomials completely.  
4. Rewriting and solving polynomials in different forms.  
5. Interpreting graphs of polynomials understanding key feature.  
6. Choosing the best way to solve problems. |
| 4. What is an inverse function and how can it be used?  
1. How to use properties of exponents with rational exponents.  
2. How to switch between radical and exponential form and simplify.  
3. How to perform operations on functions, including composition and find domain restrictions.  
4. How to solve rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.  
5. How to find inverse functions and understand domain restrictions to provide inverse functions.  
6. How to verify by composition that one function is the inverse of another.  
7. How to read values of an inverse function from a graph or a table, given that the function has an inverse.  
8. How to graph square root and cube root functions using inverse functions. | 1. Extending the properties of exponents to rational exponents.  
2. Rewriting expressions involving radicals and rational exponents using the properties of exponents.  
3. Understanding solving equations as a process of reasoning and explain the reasoning  
4. Understanding the concept of a function and use function notation. |
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<td>2.Connections in Quadratics: Using different forms of a quadratic equations, students will identify important characteristics of the function and then graph the function. The template is set up like a puzzle and the students will have to use the information given for the 6 functions to complete the task.</td>
<td>2.Flipped Classroom: Analyze expressions and apply appropriate properties of exponents.</td>
<td>2.Flipped Classroom: Khan Academy: Rational exponents.</td>
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<td>1.Desmos graphing activity to create different graphs of absolute value functions and quadratic functions. Use observations to compare and contrast the equations to the graphs and create “rules” for graphing using the parts of the equation.</td>
<td>1.End behavior discovery activity in groups.</td>
<td>1.Activity p 421: Synthesize concepts of inverse functions using notes, and examples</td>
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<td>2.Discovery activity, p 336, Investigating number of solutions.</td>
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<td>5.Daily student self evaluation indicating understanding of material. 1-3-5.</td>
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<td>A. Perform arithmetic operations with complex numbers.</td>
<td>C. Use complex numbers in polynomial identities and equations.</td>
<td>A. Extend the properties of exponents to rational exponents.</td>
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<td>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.</td>
<td>9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.</td>
<td>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.</td>
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<td>2. Use the relation i^2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.</td>
<td>A-SSE:2</td>
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<td>3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers</td>
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2. Group work to allow teacher to assist learning and evaluate understanding.
3. Opening and closing activities.
4. Daily student self-evaluation indicating understanding of material. 1-3-5.
| C. Use complex numbers in polynomial identities and equations. |
|---------------------|---------------------|
| 7. Solve quadratic equations with real coefficients that have complex solutions A-SSE:1-3 |
| A. Interpret the structure of expressions 1. Interpret expressions that represent a quantity in terms of its context. 1 a. Interpret parts of an expression, such as terms, factors, and coefficients. 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 \((x^2 - y^2)(x^2 + y^2)\). B. Write expressions in equivalent forms to solve problems 3. Choose and produce an equivalent form of an expression to reveal the maximum or minimum value of the function it defines. 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. A-CED:2 A. Create equations that describe numbers or relationships. 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A-REI:4, 10 B. Solve equations and inequalities in one variable. 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 squares that can be factored as \((x^2 - y^2)(x^2 + y^2)\). A-APR:1-5 A. Perform arithmetic operations on polynomials 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. B. Understand the relationship between zeros and factors of polynomials 2. Know and apply the Remainder Theorem: For a polynomial \(p(x)\) and a number \(a\), the remainder on division by \(x - a\) is \(p(a)\), so \(p(a) = 0\) if and only if \((x - a)\) is a factor of \(p(x)\). 3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. C. Use polynomial identities to solve problems 4. Prove polynomial identities and use them to describe numerical relationships. For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity \((x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2\) 2 can be used to generate Pythagorean triples. 5. (+) Know and apply the Binomial Theorem for the expansion of \((x + y)^n\) in powers of \(x\) and \(y\) for a positive integer \(n\), where \(x\) and \(y\) are any numbers, with coefficients determined for example by Pascal’s Triangle. 2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. A-REI:1,2,10,11 A. Understand solving equations as a process of reasoning and explain the reasoning 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. 2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. 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). 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.★ F-IF:1,2 A. Understand the concept of a function and use function notation
same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for \(x^2 = 49\)), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as \(a \pm bi\) for real numbers \(a\) and \(b\.

D. Represent and solve equations and inequalities graphically

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).

F-IF:4, 7, 8

B. Interpret functions that arise in applications in terms of the context

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

C. Analyze functions using different representations

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 polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

8. Write a function defined by an expression in different but equivalent forms to reveal and

A-CED:2

A. Create equations that describe numbers or relationships

2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A-REI:4

B. Solve equations and inequalities in one variable

4. Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in \(x\) into an equation of the form \((x – p)^2 = q\) that has the same solutions. Derive the quadratic formula from this form.

b. Solve quadratic equations by inspection (e.g., for \(x^2 = 49\)), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as \(a \pm bi\) for real numbers \(a\) and \(b\).

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c. Graph rational functions, identifying zeros when suitable factorizations are available, and showing asymptotes.

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Support Standards:
NJSLSA.R4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.  
N-Q:1  
A. Reason quantitatively and use units to solve problems.  
F-IF:1,2  
A. Understand the concept of a function and use function notation  
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 \( y = f(x) \).  
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.  

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CRP Standards:
CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.

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  2. Use the relation \( i^2 = -1 \) and the commutative, associative, and
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3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers
A-REI: 10
D. Represent and solve equations and inequalities graphically
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### Enduring Understandings

1. Logarithmic functions are inverses of exponential functions.
2. Inverses of functions provide information to solve problems.
3. A log is an operation on a number.
4. Symbolic statements can be manipulated to produce other statements of the same relationship.
5. The characteristics of exponential and logarithmic functions and their representations are useful when solving real-world problems.
6. We do not always connect the points on a graph.

### Essential Questions

1. How are exponential and logarithmic functions related?
2. When is an expression simplified?
3. When is it advantageous to transform an equation in order to solve?
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<tr>
<th>Content Knowledge</th>
<th>Major Skills</th>
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</table>
| 1. How to identify key features of exponential and logarithmic functions.  
2. How to compare exponential and logarithmic functions.  
3. How to use and apply the number “e”.  
4. How to use and apply the properties of logarithms.  
5. The relationships between exponential and logarithmic functions.  
6. How to solve real world applications for exponential and logarithmic functions.  
2. Creating equations that describe numbers or relationships.  
3. Applying compound interest formulas.  
4. Manipulating log expressions.  
5. Solving exponential and logarithmic functions.  
6. Writing expressions in equivalent forms to solve problems  
7. Creating equations that describe numbers or relationships.  
8. Using equations to describe geometric sequences and series. | 1. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.  
2. Use the structure of an expression to identify ways to rewrite it.  
3. Simplify complex fractions.  
4. Solve simple rational equations in one variable, and give examples showing how extraneous solutions may arise.  
5. Apply concepts of rational functions to domain and range. |
9. Applying concepts of exponential and logarithmic functions to domain and range.

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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).
11. Explain why the x-coordinates of the points where the graphs of the equations \( y = f(x) \) and \( y = g(x) \) intersect are the solutions of the equation \( f(x) = g(x) \); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where \( f(x) \) and/or \( g(x) \) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.★

A-

- CED:1,2
A. Create equations that describe numbers or relationships
   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.
   2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
F-IF:7, 8
C. Analyze functions using different representations
   7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★
   e. Graph exponential and logarithmic functions, showing intercepts and end behavior.

F-IF:7
D. Represent and solve equations and inequalities graphically
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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.

Support Standards:
8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
   b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)^t, y = (0.97)^t, y = (1.01)^{12t}, y = (1.2)^{t/10}, and classify them as representing exponential growth or decay.
F-BF:1,3,4,5
A. Build a function that models a relationship between two quantities
   1. Write a function that describes a relationship between two quantities.★
   c. (+) 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.
B. Build new functions from existing functions
   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.
   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 NJSLSA.R4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
N-Q:1
A. Reason quantitatively and use units to solve problems.
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   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).
   2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
8.1.12.D.4 Research and understand the positive and negative impact of one’s digital footprint.
8.1.12.D.5 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
expression for the inverse. For example, 
f(x) = 2x^3 or f(x) = (x+1)/(x−1) for x ≠1.
b. (+) Verify by composition that one function is the inverse of another.
c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
5. (+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.

Support Standards:
NJSLSA.R4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
N-Q:1
A. Reason quantitatively and use units to solve problems.
F-IF:1, 2
A. Understand the concept of a function and use function notation
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2. Use function notation, evaluate functions for inputs in their domains, and interpret

9.2.12.C.1 Review career goals and determine steps necessary for attainment.
9.2.12.C.3 Identify transferable career skills and design alternate career plans

CRP Standards:
CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.
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