ALGEBRA II
GRADES 10-12

THE EWING PUBLIC SCHOOLS
2099 Pennington Road
Ewing, NJ 08618

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In accordance with The Ewing Public Schools' Policy 2230, Course Guides, this curriculum has been reviewed and found to be in compliance with all policies and all affirmative action criteria.

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Course Description and Rationale

Algebra II is a 'gateway' course to higher mathematics. This course will build upon the foundations laid out in Algebra I and Geometry. Algebra II will lay a critical foundation that bridges these core mathematics to Pre-Calculus.

In Algebra II, students will study the complex number system and functions. Real-world problems are discussed, represented and solved using advanced algebraic techniques. The properties and algebra of functions, including polynomial, exponential, logarithmic, piece-wise, radical and rational, are analyzed and applied, as well as conics, matrices, systems of equations, sequences and series.

The Ewing Public Schools' Math Vision

The Ewing Public Schools will deliver an instructional program in mathematics where students are actively engaged in the discovery of math concepts and are applying these concepts in ways that they find meaningful and relevant.

Ewing students will be mathematical thinkers who can reason, communicate and solve problems.

Ultimately, Ewing students will master and will be able to utilize these math concepts and skills throughout their lives.

21st Century Skills - During this course, students will work on developing, to an age appropriate level, the following 21st century skills:

Career Readiness Pathways:

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP12. Work productively in teams while using cultural global competence.

Learning and Innovation Skills

Creativity and Innovation

Think Creatively

- Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others

- View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes

CRITICAL THINKING AND PROBLEM SOLVING

Reason Effectively

- Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Use Systems Thinking

- Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Make Judgments and Decisions

- Effectively analyze and evaluate evidence, arguments, claims and beliefs
- Synthesize and make connections between information and arguments
- Interpret information and draw conclusions based on the best analysis

Solve Problems

- Identify and ask significant questions that clarify various points of view and lead to better solutions

COMMUNICATION AND COLLABORATION

Communicate Clearly

- Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions
- Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)
- Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact
- Communicate effectively in diverse environments (including multi-lingual)

Collaborate with Others

- Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

Information, Media, and Technology Skills

Informational Literacy

Access and Evaluate Information

- Evaluate information critically and competently

Use and Manage Information

- Use information accurately and creatively for the issue or problem at hand

Life and Career Skills

Social and Cross-Cultural Skills

Interact Effectively with Others

- Know when it is appropriate to listen and when to speak

Work Effectively in Diverse Teams

- Respond open-mindedly to different ideas and values

Be Responsible to Others

- Act responsibly with the interests of the larger community in mind

Technology Integration

8.1 Educational Technology
All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.

ELA Integration:

SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with peers on *grades 11–12 topics, texts, and issues,* building on others' ideas and expressing their own clearly and persuasively.

A. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well reasoned exchange of ideas.
B. Collaborate with peers to promote civil, democratic discussions and decision-making, set clear goals and assessments (e.g. student developed rubrics), and establish individual roles as needed.
C. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
D. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task. SL.11-12.2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SL.11-12.3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

Unit 1: Equations and Inequalities

Why Is This Unit Important?

This introductory unit will serve to develop the basic Algebra skills needed to succeed in this course. The big ideas embedded through this unit are:

- Real Numbers and Number Operations
- Algebraic Expressions and Models
- Solving Linear Equations
- Rewriting Equations and Formulas
- Problem Solving Using Algebraic Models
- Solving Linear Inequalities
- Solving Absolute Value Equations and Inequalities

Enduring Understandings: Students will understand how to:

- Use a number line to graph and order real numbers
- Identify properties of and use operations with real numbers
- Evaluate algebraic expressions
- Simplify algebraic expressions by combining like terms
- Solve linear equations
- Rewrite equations with more than one variable
- Rewrite common formulas
- Solve simple inequalities
- Solve compound inequalities
- Solve absolute value equations and inequalities

Essential Questions:

- How do you use a number line to graph and order real numbers?
- How do you identify properties of and use operations with real numbers?
- How do you evaluate algebraic expressions?
- How do you simplify algebraic expressions by combining like terms?
- How do you solve linear equations?
- How do you rewrite equations with more than one variable?
- How do you rewrite common formulas?
- How do you solve simple inequalities?
- How do you solve compound inequalities?
- How do you solve absolute value equations and inequalities?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Order real numbers
- Identify properties of real numbers
- Know subsets of real numbers
- Know the order of operations
- Know the difference between disjoint and conjunction inequalities

Acquired Skills: After studying the material of this unit, the students should be able to:

- Use a number line to graph real numbers
- Use operations with real numbers
- Evaluate algebraic expressions
- Simplify algebraic expressions by combining like terms
- Solve linear equations
- Rewrite equations with more than one variable
- Rewrite common formulas
- Solve simple inequalities
- Solve compound inequalities
- Solve Absolute value equations and inequalities

Differentiation:

Enrichment:

- Theorems and Proof
- Theorems about Order and Absolute Value

Supplement:

- Evaluating Expressions
- Solving an Inequality

Assessments:

Formative Assessments:

- Assessment Checklist for Solving Expressions
- Assessment Checklist for Solving Equations
- Assessment Checklist for Solving Inequalities
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Equalities and Inequalities Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-SSE.1-3
NJSLS. A-CED.1-4
NJSLS. A-REI 1, 3
NJSLS. SSE.B.4
NJSLS.F-IF.1-2, 9
NJSLS.F-BF.3
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- High Speed Trains
- Using Tables to Solve Equations
- Equations with More Than One Variable
- Investigating Properties of Inequalities
- Absolute Value Equations and Inequalities

Unit 2: Linear Equations and Functions

Why Is This Unit Important?

Functions are used to model and analyze quantitative relationships in real-world applications. In this unit, students deepen their understanding of functions by investigating piecewise, step, absolute value and inverse functions. Students extend their understanding of function notation by adding, subtracting, multiplying and dividing functions, and determining the composition of functions. They investigate inverse functions and determine which functions have inverses that are functions. Students connect the concepts of transformations from previous courses to function notation. The big ideas embedded through this unit are:

- Functions and Their Graphs
- Slope and Rate of Change
- Quick Graphs of Linear Equations
- Writing Equations of Lines
- Correlation and Best-Fitting Lines
- Piecewise Functions
- Absolute Value Functions

Enduring Understandings: Students will understand how:

- Relations and functions can be represented numerically, graphically, algebraically and/or verbally
- The properties of functions and function operations are used to model and analyze real world applications and quantitative relationships
- Relations and functions are represented
- To graph and evaluate linear functions
- To find slopes of lines and classify parallel and perpendicular lines
- To use the slope-intercept form of a linear equation to graph
- To use the standard form of a linear equation to graph
- To write linear equations
- To write direct variation equations
- To use a scatter plot to identify the correlation shown by a set data
- To approximate the best-fitting line for a set of data
- To graph linear inequalities in two variables
- To represent absolute value functions

Essential Questions:

- Why are relations and functions represented in multiple ways?
- How are the properties of functions and functional operations useful?
- How do you represent relations and functions?
- How do you graph and evaluate linear functions?
- How do you find slopes of lines and classify parallel and perpendicular lines?
- How do you use the slope-intercept form of a linear equation to graph?

- How do you use the standard form of a linear equation to graph?
- How do you write linear equations?
- How do you write direct variation equations?
- How do you use a scatter plot to identify the correlation shown by a set data?
- How do you approximate the best-fitting line for a set of data?
- How do you graph linear inequalities in two variables?
- How do you represent absolute value functions?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Represent relations and functions
- Classify parallel and perpendicular lines
- Use a scatter plot to identify the correlation shown by a set data
- Know the vertical line test
- Know the slope formula
- Know the equations of a line in slope-intercept, point-slope and standard forms
- Know the slopes of vertical and horizontal lines
- Know the standard form for the equation of an absolute value function

Acquired Skills: After studying the material of this unit, the students should be able to:

- Graph linear functions
- Evaluate linear functions
- Find slopes of lines
- Use the slope-intercept form of a linear equation to graph
- Use the standard form of a linear equation to graph
- Write linear equations
- Write direct variation equations
- Approximate the best-fitting line for a set of data
- Graph linear inequalities in two variables
- Represent absolute value functions

Differentiation:

Enrichment:

- Symbolic Logic: Boolean Algebra

Supplement:

- Investigating Slope and Y-Intercept
- Fitting a Line to a Set of Data

Assessments:

Formative Assessments:

- Assessment Checklist for Representing Functions
- Assessment Checklist for Solving Functions
- Assessment Checklist for Solving Inequalities
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Linear Equations and Functions Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-REI 10-2
NJSLS.F-IF.6
NJSLS.F-BF.1, 4
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Youth Service
- Transatlantic Voyages
- Graphing Equations
- Using Linear Regression
- Investigating a Graph of an Inequality
- Graphing Piecewise Functions
- Graphs of Absolute Value Functions

Unit 3: Systems of Linear Equations and Inequalities

Why Is This Unit Important?

Linear systems are used to model and solve real-world problems. In this unit, students formalize their understanding of linear systems. In Algebra I, students solved linear systems of two equations. Students begin this unit by solving applications involving systems of two equations. Students solve linear systems of three equations in three unknowns. The big ideas embedded through this unit are:

- Solving Linear Systems by Graphing
- Solving Linear Systems Algebraically
- Graphing and Solving Systems of Linear Inequality
- Solving Systems of Linear Equality in Three Variables

Enduring Understandings: Students will understand how:

- A variety of representations of linear systems of equations are used to model and solve real-world problems
- Graphing can be used to solve systems of linear equations in two variables
- Algebraic methods can be used to solve linear systems
- Graphing a system of linear inequalities can be used to find the solutions of the system
- Systems if linear equations in three variables can be solved

Essential Questions:

- What methods can be used to solve systems of equations?
- How are systems of linear equations useful?
- How do you graph and solve systems of linear equations in two variables?
- How do you use algebraic methods to solve linear systems?
- How do you graph a system of linear inequalities to find the solutions of the system?
- How do you solve systems if linear equations in three variables?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Know the steps for solving systems graphically, substitution, linear combinations
- Know when systems of linear equations have none, one or infinitely many solutions

Acquired Skills: After studying the material of this unit, the students should be able to:

- Graph systems of linear equations in two variables to solve the system
- Use algebraic methods to solve linear systems
- Graph a system of linear inequalities to find the solutions of the system
- Solve Systems if Linear equations in three variables

Differentiation:

Enrichment:

- Drawing with Linear Perspective
- Problem Solving Using Systems
- Relations
- Linear Programming
- Products and Factors of Polynomials

Supplement:

- Investigating Graphs of Systems of Inequalities
- Investigating Linear Programming

Assessments:

Formative Assessments:

- Assessment Checklist for Modeling Systems of Equations
- Assessment Checklist for Graphing Systems of Equations
- Assessment Checklist for Algebraically Solving Systems of Equations
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Systems of Linear Equations and Inequalities Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-REI 5-7
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Cross Training
- Graphing Systems of Equations
- Combining Equations in a Linear System
- Linear Programming in World War II
- Graphing Linear Equations in Three Variables

Unit 4: Matrices and Determinants

Why Is This Unit Important?

Matrices are used to model and solve real-world problems. In this unit, students formalize their understanding of matrices. Operations on matrices, such as addition, subtraction, scalar multiplication and matrix multiplication, are studied. Students evaluate the determinant of a matrix and find the inverse of a square matrix. Systems of equations are solved using matrix equations and inverse matrices. In an optional enrichment section, systems of equations are solved using augmented matrices. The big ideas embedded through this unit are:

- Matrix Operations
- Multiplying Matrices
- Determinants and Cramer's Rule
- Identity and Inverse Matrices
- Solving Systems Using Inverse Matrices

Enduring Understandings: Students will understand how to:

- Add and subtract matrices, multiply a matrix by a scalar, and solve matrix equations
- Multiply two matrices
- Evaluate determinants of 2x2 and 3x3 matrices
- Use Cramer's rule to solve systems of linear equations
- Find and use inverse matrices
- Solve systems of linear equations using inverse matrices

Essential Questions:

- How do you add and subtract matrices, multiply a matrix by a scalar, and solve matrix equations?
- How do you multiply two matrices?
- How do you evaluate determinants of 2x2 and 3x3 matrices?
- How do you use Cramer's rule to solve systems of linear equations?
- How do you find and use inverse matrices?
- How do you solve systems of linear equations using inverse matrices?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Know how to identify the dimensions of a matrix
- Know the properties of matrix operations
- Know the steps to take to use Cramer's Rule to solve linear equations
- Know the steps to take to solve linear systems with using inverses
- Know the steps to find the area of a triangle using matrices

Acquired Skills: After studying the material of this unit, the students should be able to:

- Add and subtract matrices
- Multiply a matrix by a scalar
- Solve matrix equations
- Multiply two matrices
- Evaluate determinants of 2x2 and 3x3 matrices

Differentiation:

Enrichment:

- Applications of Matrices
- Solving Systems Using Augmented Matrices

Supplement:

- Investigating Matrix equations

Assessments:

Formative Assessments:

- Assessment Checklist for Solving Matrices Equations
- Assessment Checklist for Inverse Matrices
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Matrices and Determinants Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-REI 8-9
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Using Matrix Operations
- Investigating Identity and Inverse Matrices
- Systems of Equations

Unit 5: Quadratic Functions

Why Is This Unit Important?

In this unit, students deepen their understanding of quadratic functions by extending the domain and range to the set of complex numbers. Students extend their knowledge of number properties and operations to the set of complex numbers. Students solve quadratic inequalities using the graph of the related quadratic function. In Algebra II with analysis, students represent quadratic functions given points on the graph. The big ideas embedded through this unit are:

- Graphing Quadratic Functions
- Solving Quadratic Equations by Factoring
- Solving Quadratic Functions by Finding Square Roots
- Complex Numbers
- Completing the Square
- The Quadratic Formula and the Discriminant
- Graphing and Solving Quadratic Inequalities
- Modeling with Quadratic Functions

Enduring Understandings: Students will understand how to:

- Graph quadratic functions
- Factor quadratic expressions and solve quadratic equations by factoring
- Find zeros of quadratic functions
- Solve quadratic equations by finding square roots
- Solve quadratic equations with complex solutions and perform operations with complex numbers.
- Solve quadratic equations by completing the square
- Use completing the square to write quadratic functions in form
- Solve quadratic equations using the quadratic formula
- Graph quadratic inequalities in tow variables
- Write quadratic functions given characteristics of their graphs

Essential Questions:

- How do you graph quadratic functions?
- How do you factor quadratic expressions and solve quadratic equations by factoring?
- How do you find zeros of quadratic functions?
- How do you solve quadratic equations by finding square roots?
- How do you solve quadratic equations with complex solutions and perform operations with complex numbers?
- How do you solve quadratic equations by completing the square?
- How do you use completing the square to write quadratic functions in form?
- How do you solve quadratic equations using the quadratic formula?
- How do you graph quadratic inequalities in tow variables?
- How do you write quadratic functions given characteristics of their graphs?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Identify a quadratic function
- Identify the zeros of a quadratic function from a graph
- Know the procedure factor quadratic expressions
- Know the procedures solve quadratic equations by using factoring, square rooting, completing the square, and the quadratic formula
- Know the quadratic formula
- Know how the discriminant defines the nature of the roots
- Know the equations of a quadratic function in standard, vertex and x-intercept form
- Know the zero product property
- Know properties of square roots
- Know the definition of *i*
- Know the formula to find the absolute value for a complex number

Acquired Skills: After studying the material of this unit, the students should be able to:

- Graph quadratic functions
- Factor quadratic expressions and solve quadratic equations by factoring
- Find zeros of quadratic functions
- Solve quadratic equations by finding square roots
- Solve quadratic equations with complex solutions and perform operations with complex numbers
- Solve quadratic equations by completing the square
- Use completing the square to write quadratic functions in form
- Solve quadratic equations using the quadratic formula
- Graph quadratic inequalities in tow variables
- Write quadratic functions given characteristics of their graphs

Differentiation:

Enrichment:

- Applications of Quadratic Functions

Supplement:

- Investigating Parabolas
- Investigating Properties of Square Roots
- Using Algebra Tiles to Complete the Square

Assessments:

Formative Assessments:

- Assessment Checklist for Solving Quadratic Equations
- Assessment Checklist for Solving Quadratic Inequalities
- Teacher's observation of students at work; anecdotal records
  - Individual conferences and group discussions
  - Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Quadratic Functions Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-REI 4
NJSLS.F-IF.8
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Volcanoes
- Telescopes
- Solving Quadratic Equations
- Finding Maximums and Minimums
- Writing a Quadratic in Standard Form

Unit 6: Polynomials and Polynomial Functions

Why Is This Unit Important?

In this unit, students develop an understanding of polynomial functions of degree greater than two by analyzing their graphs and finding the zeros using various techniques. Students use finite differences to determine the degree of a polynomial function represented numerically, then determine the function using polynomial regression. In Algebra II with analysis, students solve polynomial inequalities algebraically. The big ideas embedded through this unit are:

- Using Properties of Exponents
- Evaluating Polynomial Functions
- Adding, Subtracting, and Multiplying Polynomials
- Factoring and Solving Polynomial Equations
- The Remainder and Factor Theorems
- Finding Rational Zeros
- Using the Fundamental Theorem of Algebra

Enduring Understandings: Students will understand how:

- The characteristics of polynomial functions and their representations are useful in solving real-world problems
- The domain and range of polynomial functions can be extended to include the set of complex numbers.
- Properties of exponents can be used to evaluate and simplify expressions involving powers
- To evaluate a polynomial function
- To graph a polynomial function
- To add, subtract, and multiply polynomials
- To factor polynomial expressions
- To use factoring to solve polynomial equations
- To divide polynomials and relate the result to the factor theorem
- To find the rational zeros of a polynomial function
- To use the fundamental theorem of algebra to determine the number of zeros of a polynomial function

Essential Questions:

- How do polynomial functions model real-world problems and their solutions?
- Why are complex numbers necessary?
- How are operations and properties of complex numbers related to those of real numbers?
- How do you use properties of exponents to evaluate and simplify expressions?
- How do you evaluate a polynomial function?
- How do you graph a polynomial function?

- How do you add, subtract, and multiply polynomials?
- How do you factor polynomial expressions?
- How do you Use factoring to solve polynomial equations?
- How do you Divide polynomials and relate the result to the factor theorem?
- How do you find the rational zeros of a polynomial function?
- How do you Use the fundamental theorem of algebra to determine the number of zeros of a polynomial function?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Know the properties of exponents
- Know the Fundamental Theorem of Algebra
- Know the rational Root Theorem
- Know the Conjugate Root Theorem
- Know how to categorize a polynomial in standard form by degree and type
- Know the procedure to evaluate polynomials using direct and synthetic substitution
- Know special product patterns and special factoring patterns
- Know the remainder and factor theorems

Acquired Skills: After studying the material of this unit, the students should be able to:

- Use the properties of exponents to simplify expressions
- Evaluate a polynomial function
- Graph a polynomial function
- Add, subtract, and multiply polynomials
- Factor polynomial expressions
- Use factoring to solve polynomial equations
- Divide polynomials and relate the result to the factor theorem
- Find the rational zeros of a polynomial function
- Use the fundamental theorem of algebra to determine the number of zeros of a polynomial function

Differentiation:

Enrichment:

- Magic Squares

Supplement:

- Products and Quotients of Powers
- The Difference of Two Cubes

Assessments:

Formative Assessments:

- Assessment Checklist for Solving Polynomial Functions
- Assessment Checklist for Simplifying Polynomial Expressions
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Polynomials and Polynomial Functions Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-APR.1-4
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Space Exploration
- Investigating End Behavior
- Setting a Good Viewing Window
- Solving Polynomial Equations
- Investigating Polynomial Division
- Investigating the Number of Solutions
- Solving Polynomial Equations
- Exploring Finite Differences

Unit 7: Powers, Roots and Radicals

Why Is This Unit Important?

This unit will serve to develop the skills needed to use properties of rational exponents and use those properties to solve equations. It will also serve to develop the skills to utilize operations on functions and how you find the inverse of functions. It will serve to introduce students to the different measures of central tendencies of statistical data and how to represent them graphically. The big ideas embedded through this unit are:

- nth Roots and Rational Exponents
- Properties of Rational Exponents
- Power Functions and Function Operations
- Inverse Functions
- Solving Radical Equations
- Statistics and Statistical Graphs

Enduring Understandings: Students will understand how to:

- Evaluate nth roots of real numbers using both radical notation and rational exponent notation
- Use properties of rational exponents to evaluate and simplify expressions
- Perform operations with functions including power functions
- Find inverses of linear functions
- Find inverses of nonlinear functions
- Solve equations that contain radicals or rational exponents
- Use measures of central tendency and measures of dispersion to describe data sets
- Use box-and-whisker plots and histograms to represent data graphically

Essential Questions:

- How do you evaluate nth roots of real numbers using both radical notation and rational exponent notation?
- How do you use properties of rational exponents to evaluate and simplify expressions?
- How do you perform operations with functions including power functions?
- How do you find inverses of linear functions?
- How do you find inverses of nonlinear functions?
- How do you solve equations that contain radicals or rational exponents?
- How do you use measures of central tendency and measures of dispersion to describe data sets?
- How do you se box-and-whisker plots and histograms to represent data graphically?

Acquired Knowledge: After studying the material of this unit, the students should be able to know:

- Properties of rational exponents
- What the composition of two functions is
- What inverse functions are
- The measures of central tendency
- Measures of dispersion
- What are box-and –whisker plots, histograms and frequency distribution tables

Acquired Skills: After studying the material of this unit, the students should be able to:

- Evaluate nth roots of real numbers using both radical notation and rational exponent notation
- Use properties of rational exponents to evaluate and simplify expressions
- Perform operations with functions including power functions
- Find inverses of linear functions
- Find inverses of nonlinear functions
- Solve equations that contain radicals or rational exponents
- Use measures of central tendency and measures of dispersion to describe data sets
- Use box-and-whisker plots and histograms to represent data graphically

Differentiation:

Enrichment:

- Reading Algebra for Problem Solving
- Linear Interpolation

Supplement:

- Investigating Graphs of Radical Functions

Assessments:

Formative Assessments:

- Assessment Checklist for Power Functions
- Assessment Checklist for Inverse Functions
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Power, Roots, and Radicals Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-APR.5
NJSLS.F-IF.8
NJSLS.F-BF.5
NJSLS.F-LE.4
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Dinosaurs
- Exploring Inverse Functions
- Graphing Inverse Functions
- Tsunamis
- Statistics and Statistical Graphs

Unit 8: Rational Equations and Functions

Why Is This Unit Important?

In this unit, students extend their knowledge of variation to inverse and joint variation problems and their applications. Students analyze, graph and apply rational functions with linear denominators. Students simplify, add, subtract, multiply and divide rational expressions and simplify complex fractions. Students solve and apply rational equations. The big ideas embedded through this unit are:

- Inverse and Joint Variation
- Multiplying and Dividing Rational Expressions
- Addition, Subtraction, and Complex Fractions
- Solving Rational Equations

Enduring Understandings: Students will understand how to:

- Write and use inverse variation models
- Write and use joint variation models
- Multiply and divide rational expressions
- Add and subtract rational expressions
- Simplify complex fractions
- Solve rational equations

Essential Questions:

- How do rational functions model real-world problems and their solutions?
- How do you write and use inverse variation models?
- How do you write and use joint variation models?
- How do you multiply and divide rational expressions?
- How do you add and subtract rational expressions?
- How do you simplify complex fractions?
- How do you solve rational equations?

Acquired Knowledge: After studying the material of this unit, the students should be able to know:

- The equations for inverse and joint variation equations
- How to simplify rational expressions
- What a complex fraction is

Acquired Skills: After studying the material of this unit, the students should be able to:

- Write and use inverse variation models
- Write and use joint variation models
- Multiply and divide rational expressions
- Add and subtract rational expressions
- Simplify complex fractions
- Solve rational equations

Assessments:

Formative Assessments:

- Assessment Checklist for Joint Variation
- Assessment Checklist for Inverse Variation
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Rational Equations and Functions Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-REI.2
NJSLS.MP.1-8

Differentiation:

Enrichment:

- Applications of Irrational and Complex Numbers

Supplement:

- Investigating Inverse Variation

Suggested Learning Experiences and Instructional Activities:

- Skydiving
- Graphing Rational Functions
- Operations with rational Expressions
- Deep Water Diving

Unit 9: Sequences and Series

Why Is This Unit Important?

In this unit, students extend their knowledge of sequences and series from previous courses. Sequences are defined as functions whose domains are the set of natural numbers. Students apply explicit and recursive rules for arithmetic and geometric sequences, and determine the sum of finite arithmetic and geometric series. The big ideas embedded through this unit are:

- An Introduction to Sequences and Series
- Arithmetic Sequences and Series
- Geometric Sequences and Series
- Infinite Geometric Series

Enduring Understandings: Students will understand how:

- Sequences and series are discrete functions whose domain is the set of whole numbers
- To use and write sequences
- To use summation notation to write series and find sums of series
- To write rules for arithmetic sequences and find the sums of arithmetic series
- To write rules for geometric sequences and find the sums of geometric series
- To find sums of infinite geometric series

Essential Questions:

- How do sequences and series model real-world problems and their solutions?
- How do you use and write sequences?
- How do you use summation notation to write series and find sums of series?
- How do you write rules for arithmetic sequences and find the sums of arithmetic series?
- How do you write rules for geometric sequences and find the sums of geometric series?
- How do you find sums of infinite geometric series?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Identify arithmetic and geometric sequences
- Know the rule for arithmetic and geometric sequences
- Know the formulas to find the sum of a finite arithmetic or geometric series
- Know the formula to find the sum of an infinite geometric series

Acquired Skills: After studying the material of this unit, the students should be able to:

- Use and write sequences
- Use summation notation to write series and find sums of series
- Write rules for arithmetic sequences and find the sums of arithmetic series
- Write rules for geometric sequences and find the sums of geometric series
- Find sums of infinite geometric series

Differentiation:

Enrichment:

- Mathematical Induction
- Applications of Series

Supplement:

- Investigating Recursive Rules

Assessments:

Formative Assessments:

- Assessment Checklist for Sequences
- Assessment Checklist for Series
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Sequences and Series Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. A-SSE.4
NJSLS.F-IF.3
NJSLS.F-BF.2
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Fractals
- Working with Sequences
- Investigating an Infinite Geometric Series
- The Fibonacci Sequence
- Evaluating Recursive Rules

Unit 10: Probability

Why Is This Unit Important?

This unit will serve to develop the skills needed to calculate total outcomes of an event and probabilities. The big ideas embedded through this unit are:

- The Fundamental Counting Principle and Permutations
- Combinations and Binomial Theorem
- An Introduction to Probability
- Probability of Compound Events
- Probability of Independent and Dependent Events

Enduring Understandings: Students will understand how to:

- Use the fundamental counting principle to count the number of ways an event can happen
- Use permutations to count the number of ways an event can happen
- Use combinations to count the number of ways an event can happen
- Use the binomial theorem to expand a binomial that is raised to a power
- Find theoretical and experimental probabilities
- Find geometric probabilities
- Find probabilities of unions and intersections of two events
- Use compliments to find the probability of an event
- Find the probability of independent events
- Find the probability of dependent events

Essential Questions:

- How do you use the fundamental counting principle to count the number of ways an event can happen?
- How do you use permutations to count the number of ways an event can happen?
- How do you use combinations to count the number of ways an event can happen?
- How do you use the binomial theorem to expand a binomial that is raised to a power?
- How do you find theoretical and experimental probabilities?
- How do you find geometric probabilities?
- How do you find probabilities of unions and intersections of two events?
- How do you use compliments to find the probability of an event?
- How do you find the probability of independent events?
- How do you find the probability of dependent events?

Acquired Knowledge: After studying the material of this unit, the students should be able to:

- Know the Fundamental Counting Principle
- Know when to use permutations vs. combinations when finding the number of outcomes for events
- Know the formula to find the number of permutations when there is repetition
- Know the formulas to find the theoretical, experimental, and geometric probabilities of an event
- Know the difference between compound and mutually exclusive events
- Know the formulas for compound and mutually exclusive events
- Know what the compliment of an event is
- Know the difference of an independent and dependent event
- Know the formulas to find the probability of dependent and independent events

Acquired Skills: After studying the material of this unit, the students should be able to:

- Use the fundamental counting principle to count the number of ways an event can happen
- Use permutations to count the number of ways an event can happen
- Use combinations to count the number of ways an event can happen
- Use the binomial theorem to expand a binomial that is raised to a power
- Find theoretical and experimental probabilities
- Find geometric probabilities
- Find probabilities of unions and intersections of two events
- Use compliments to find the probability of an event
- Find the probability of independent events
- Find the probability of dependent events

Differentiation:

Enrichment:

- Expected value
- Capture-Recapture

Supplement:

- Investigating Pascal's Triangle
- Probability theory

Assessments:

Formative Assessments:

- Assessment Checklist for Permutations
- Assessment Checklist for Combinations
- Teacher's observation of students at work; anecdotal records
- Individual conferences and group discussions
- Students' recording sheets

Summative Assessments:

- Teacher's observation of students at work
- Individual conferences
- Chapter Assessments

Benchmarks

- Probability Assessment

Alternative Assessments:

- Modified tasks and assessment rubrics
- Performance-based assessment tasks

List of Applicable New Jersey Student Learning Standards Covered in This Unit:

NJSLS. S-ID.1-7
NJSLS. S-IC.1-6
NJSLS. S-CP.1-9
NJSLS.S-MD.1-7
NJSLS.MP.1-8

Suggested Learning Experiences and Instructional Activities:

- Concerts
- Generating Random Numbers
- Investigating Binomial Distributions
- Constructing a Binomial Distribution
- Investigating Normal Distribution

Sample Standards Integration

21st Century Skills & Career Readiness Practices

CRP4. Communicate clearly and effectively and with reason.

For example, in Unit 10 students will justify their reasoning in their choice of solution pathways involving probability scenarios

CRP6. Demonstrate creativity and innovation.

For example, in Unit 3 students will use solution modeling to solve real world complex volume problems.

CRP7. Employ valid and reliable research strategies.

For example, in Unit 2 students will analyze and interpret data plots for real world scenarios.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

For example, in Unit 4 students will work to solve and understand real world applications utilizing their understanding of matrices.

CRP12. Work productively in teams while using cultural global competence.

For example, in Unit 6 students will work in small teams to develop polynomial function models.

8.1 Educational Technology

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.

For example, in Unit 5 students will access, manage, evaluate, and synthesize information to develop models for quadratic relationships.

Interdisciplinary Connections

SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with peers on *grades 11–12 topics, texts, and issues,* building on others' ideas and expressing their own clearly and persuasively.

A. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well reasoned exchange of ideas.
B. Collaborate with peers to promote civil, democratic discussions and decision-making, set clear goals and assessments (e.g. student developed rubrics), and establish individual roles as needed.
C. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
D. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task. SL.11-12.2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SL.11-12.3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

These standards are met throughout the course. For example, in Unit 7 students will discuss their solutions to a variety of real world scenarios justifying their argument with data distributions.