Black Horse Pike Regional School District

Where inspiring excellence is our standard, and student achievement is the result.

Algebra 2 Honors
Course Number: 033100

Updated: June 2024

PART I: UNIT RATIONALE

<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 2 - Quadratic Functions

Students have studied quadratic functions in Algebra 1. Their background should include factoring quadratic expressions, graphing quadratic equations written in three forms, and solving quadratic equations using a variety of approaches. Students will extend their knowledge of quadratic functions in this chapter. In the previous chapter, students looked at the transformations of linear and absolute value functions. The first lesson in this chapter introduces the same transformations on quadratic functions. The vertex of the absolute value function and the vertex of a quadratic function are key points that help students distinguish quickly the type(s) of transformation(s) displayed in a graph. The second and third lessons look at characteristics of quadratic functions. Where is the function increasing or decreasing? Where is the line of symmetry? What is the maximum/ minimum value of the function? The last lesson of the chapter looks at modeling with quadratic functions. The technique of solving systems from Chapter 1 is extended to a 3-by-3 system. There are four common forms in which quadratics are written, and each gives information about the graph and the behavior of the function. Understanding the connection between the characteristics of a quadratic and its equation can help students apply their knowledge when working with a real-life application.

Essential Questions	Learning Targets/Objectives
1. How do the constants a, h, and k affect the graph of the quadratic function $g(x) = a(x - h)^2 + k$? 2. What type of symmetry does the graph of $f(x) = a(x - h)^2 + k$ have and how can you describe this symmetry? 3. How can you use a quadratic function to model a real-life	Students will be able to: • Describe transformations of quadratic functions. • Write transformations of quadratic functions • Explore properties of parabolas. • Find maximum and minimum values of quadratic functions. • Graph quadratic functions using x-intercepts. • Solve real-life problems.

situation?	• Write equations of quadratic functions using vertices, points, and x-intercepts. • Write quadratic equations to model data sets.
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
Transformations, quadratic function, parabola, vertex of a parabola, x-intercept, axis of symmetry, average rate of change	vertex form, standard form, minimum value, maximum value, intercept form

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. A-APR.B.3	1. 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.
2. A-CED.A.2	2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. F-BF.B.3	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. F-IF.B.4	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
5. F-IF.B.6	5. 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.

	Climate Change Example: Students may calculate the average rate of change of a function c(m) presented symbolically or as a table, where c(m) represents the amount of carbon dioxide produced by burning a given number of molecules of ethane (gasoline).
6. F-IF.C.7c	6. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
7. F-IF.C.9	7. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
2. HS-PS2-2	2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
3. L.KL.9-10.2.A	3. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level.
4. W.IW.9–10.2	4. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
5. SL.PE.9-10.1.D	5. Respond thoughtfully to various perspectives, summarize points of agreement and disagreement, and justify own views. Make new connections in light of the evidence and reasoning presented.
6. SL.PI.9-10.4	6. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
2020 New Jersey Student Learning Standards for Career Readiness, Life Literacies, and Key Skills	
1. 9.1.12.CDM.1	1. Identify the purposes, advantages, and disadvantages of debt.
2. 9.1.12.CDM.8	2. Compare and compute interest and compound interest and develop an amortization table using business tools.
3. 9.4.12.IML.3	3. Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
4. 9.4.12.CI.1	4. Demonstrate the ability to reflect, analyze, and use creative skills and ideas

2020 New Jersey Student Learning Standards for Computer Science and Design Thinking	
1. 8.1.12.DA.1	1. Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
2. 8.1.12.DA.2	2. Describe the trade-offs in how and where data is organized and stored.

The 8 Mathematical Practices are embedded throughout the course and are evident in daily lessons, assignments, activities, assessments, and projects:

Make sense of problems and persevere in solving them: Take time to analyze the given information and what the problem is asking to help you to plan a solution pathway. Throughout the unit students are given problems that require them to:

- Explain the Meaning
- Find Entry Points
- Analyze Givens
- Interpret a Solution
- Make a Plan
- Consider Similar Problems
- Check Progress
- Consider Simpler Forms
- Problem Solve

Reason abstractly and quantitatively: Investigate specific examples and represent them symbolically, and observe the relationships in numbers or symbols to derive conclusions about a concrete instance. Throughout the unit students are given problems that require them to:

- Make Sense of Quantities
- Use Equations
- Use Expressions
- Understand Quantities
- Use Operations

- Contextualize
- Relationships
- Reason Abstractly

Construct viable arguments and critique the reasoning of others: Make and justify conclusions and decide whether others' arguments are correct or flawed. Throughout the unit students are given problems that require them to:

- Use Assumptions
- Use Defi nitions
- Use Prior Results
- Make Conjectures
- Build Arguments
- Analyze Conjectures
- Use Counterexamples
- Justify Conclusions
- Compare Arguments
- Construct Arguments
- Listen and Ask Questions
- Critique Reasoning
- Use Logic
- Error Analysis

Model with mathematics: Apply the mathematics to a real-life problem, and you interpret mathematical results in the context of the situation. Throughout the unit students are given problems that require them to:

- Apply Mathematics
- Simplify a Solution
- Use a Diagram
- Use a Table
- Use a Graph
- Use a Formula
- Analyze Relationships
- Interpret Results
- Model Real Life

Use appropriate tools strategically: Know what tools are available and think about how each tool might help solve a mathematical problem. Use a tool for its advantages, while being aware of its limitations. Throughout the unit students are given problems that require them to:

- Choose Tools

- Recognize Usefulness of Tools
- Use Other Resources
- Use Technology to Explore

Attend to precision: Develop a habit of being careful how you talk about concepts, label your work, and write your answers. Throughout the unit students are given problems that require them to:

- Communicate Precisely
- Use Clear Definitions
- State the Meaning of Symbols
- Specify Units
- Label Axes
- Calculate Accurately
- Understand Mathematical Terms

Look for and make use of structure: Look closely to see structure within a mathematical statement, or step back for an overview to see how individual parts make one single object. Throughout the unit students are given problems that require them to:

- View as Components
- Look for Patterns
- Look for Structure

Look for and express regularity in repeated reasoning: Notice patterns and make generalizations. Keeping in mind the goal of a problem helps you evaluate reasonableness of answers along the way. Throughout the unit students are given problems that require them to:

- Repeat Calculations
- Find General Methods
- Maintain Oversight
- Evaluate Results

Resources

Textbook

Algebra 2, A Common Core Curriculum – Big Ideas Math, Big Ideas Learning LLC., 2019

Online Resources

- BigIdeas Math
- Desmos Activities
- Pear Assessment
- IXL
- Quizizz
- EdPuzzle
- Canva
- Khan Academy
- Inside Mathematics
- NJDOE Digital Item Library
- New Jersey Center for Teaching and Learning
- New Jersey Climate Education Hub

Videos

- Finding features of quadratic equations
- Transformations of parabolas

Integrated Technology

- Google Suite: Google Classroom, Docs, Drive, Mail, etc...
- Big Ideas online program
- Devices:
    - Chromebooks
    - Texas Instrument TI-84 Plus Graphing Calculator

ML Resources

• Multi-Language Glossary
Gifted & Talented Resources
• Leveled Assessments • Enrichment worksheets

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills?

Section 2.1 - Transformations and Quadratic Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Write linear inequalities. • Sketch the graphs of linear inequalities. • Write linear inequalities from graphs	**Cumulative Practice**: graphing transformations of square root functions **Prerequisite Skills Practice:** graphing horizontal and vertical stretches and shrinks of linear functions	**Basic:** 9, 17, 33, 41 **Proficient:** 10, 16, 32, 44 **Advanced:** 12, 24, 36, 44

Section 2.2 - Characteristics of Quadratic Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
● Solve inequalities using addition. ● Solve inequalities using subtraction. ● Use inequalities to solve real-life problems.	**Cumulative Practice**: factoring polynomials **Prerequisite Skills Practice:** reflecting points over lines in the coordinate plane	**Basic:** : 5, 7, 13, 25 **Proficient:** 8, 18, 22, 26 **Advanced:** 16, 17, 24, 25

Section 2.4 - Modeling with Quadratic Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
● Solve multi-step inequalities. ● Use multi-step inequalities to solve real-life problems.	**Cumulative Practice**: finding minimum and maximum values of a quadratic function **Prerequisite Skills Practice:**writing equations in point-slope form	**Basic:** 7, 13, 17, 19, 31 **Proficient:** 8, 14, 18, 20, 32 **Advanced:** 14, 16, 22, 28, 32

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

Assessments		
Summative	**Formative**	**Performance**
The following assessments will be used to evaluate student learning, skill acquisition and academic achievement of the Standards of Mathematical Practice and the New Jersey Learning Standards for Mathematics listed under each chapter in the Algebra 1 curriculum/syllabus at the conclusion of an instructional time period. ● Diagnostic Pre-Test ● Chapter Tests ● Periodic Benchmark Tests ● Standardized Tests	The effectiveness of the instructional program will be based on numerous activities and strategies including the following and are not limited to: ● Teacher observations ● Self-Assessments ● Student record-keeping ● Quizzes ● Warm-ups ● Exit Tickets ● Participation in class discussions ● Independent practice	The following assessments require students to utilize various strands of mathematics. ● Projects ● Performance Tasks ● Homework ● Classwork
List of Accommodations and Modifications ● Special Education ● 504 Students ● At Risk Students ● MLL ● Gifted and Talented		

State Mandates and Resources
● New Jersey Student Learning Standards ● Standards for Mathematical Practices

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<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 3 - Quadratic Equations and Complex Numbers

The strategies for solving quadratic equations presented in the first four lessons were introduced at the end of Algebra 1. The difference now is that solutions are not restricted to real numbers. In Section 3.2, complex numbers are defined and operations on complex numbers presented. This is followed by the technique of completing the square so that the Quadratic Formula can be derived. In total, students will use five strategies for solving quadratic equations: graphing, square rooting, factoring, completing the square, and using the Quadratic Formula. As the number of strategies increases in the chapter, students should be making informed choices as to which strategy to use given the equation.

Essential Questions	Learning Targets/Objectives
1. How can you rewrite quadratic equations in factored form? 2. How can you use the graph of a quadratic equation to determine the number of real solutions of the equation? 3. What are the subsets of the set of complex numbers? 4. How can you complete the square for a quadratic expression? 5. How can you derive a general formula for solving a quadratic equation?	Students will be able to: • Factor GCFs out of quadratic equations. • Factor a difference of two squares • Factor a quadratic equation in the form of $ax^2 + bx + c$ • Solve quadratic equations by graphing. • Solve quadratic equations algebraically. • Solve real-life problems. • Define and use the imaginary unit i. • Add, subtract, and multiply complex numbers. • Find complex solutions and zeros • Simplify square-roots

	• Solve quadratic equations using square roots. • Solve quadratic equations by completing the square. • Solve quadratic equations using the Quadratic Formula. • Analyze the discriminant to determine the number and type of solutions. • Solve real-life problems.
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
quadratic equation in one variable, properties of square roots, factoring, real number, radical, radicand, perfect square trinomial, vertex form	root of an equation, zero of a function, rationalizing the denominator, imaginary unit i, complex number, imaginary number, pure imaginary number, completing the square, Quadratic Formula, discriminant

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. N-CN.A.1	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.
2. N-CN.A.2	2. Use the relation i^2 = –1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
3. N-CN.C.7	3. Solve quadratic equations with real coefficients that have complex solutions.
4. N-RN.A.3	4. Simplify radicals, including algebraic radicals
5. A-REI.B.4b	5. Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.

6. A-SSE.A.2	6. 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).
7. A-SSE.B.3a	7. Factor a quadratic expression to reveal the zeros of the function it defines.
8. F-IF.C.8a	8. 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.
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
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Resources

Textbook

Algebra 2, A Common Core Curriculum – Big Ideas Math, Big Ideas Learning LLC., 2019

Online Resources

- BigIdeas Math
- Desmos Activities
- Pear Assessment
- IXL
- Quizizz
- EdPuzzle
- Canva
- Khan Academy
- Inside Mathematics
- NJDOE Digital Item Library
- New Jersey Center for Teaching and Learning
- New Jersey Climate Education Hub

Videos

- Solving Quadratic Equations by Factoring
- Completing the Square
- Quadratic Formula

Integrated Technology

- Google Suite: Google Classroom, Docs, Drive, Mail, etc...
- Big Ideas online program
- Devices:
    - Chromebooks
    - Texas Instrument TI-84 Plus Graphing Calculator

ML Resources
● Multi-Language Glossary
Gifted & Talented Resources
● Leveled Assessments ● Enrichment worksheets

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills?

Supplement - Factoring Quadratic Expressions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Factor GCFs out of quadratic equations. • Factor a difference of two squares • Factor a quadratic equation in the form of $ax^2 + bx + c$	**Cumulative Practice:** using exponent rules to simplify expressions **Prerequisite Skills Practice:** multiplying two binomials	Teacher created worksheet on factoring GCFs, Difference of two squares, and trinomials in the form of $ax^2 + bx + c$

Section 3.1 - Solving Quadratic Equations		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Solve quadratic equations by graphing. • Solve quadratic equations algebraically. • Solve real-life problems.	**Cumulative Practice**: identifying a function family **Prerequisite Skills Practice:** factor quadratic expression	**Basic:** 3, 15, 27, 51, 57 **Proficient:** 10, 16, 30, 52, 70 **Advanced:** 12, 20, 30, 52, 70

Section 3.2 - Complex Numbers		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Define and use the imaginary unit i. • Add, subtract, and multiply complex numbers. • Find complex solutions and zeros	**Cumulative Practice**: writing translations of functions **Prerequisite Skills Practice:** simplifying using the distributive property	**Basic:** 7, 15, 21, 41, 51 **Proficient:** 16, 26, 42, 52, 58 **Advanced:** 20, 30, 44, 52, 58

Supplement - Simplify Radicals		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Simplify square-roots	**Cumulative Practice**: use the Pythagorean Theorem **Prerequisite Skills Practice:** evaluating square roots	Teacher created worksheet involving simplifying square roots.

Section 3.3 - Completing the Square		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Solve quadratic equations using square roots. • Solve quadratic equations by completing the square.	**Cumulative Practice**: using symmetry to graph quadratic functions **Prerequisite Skills Practice:** factoring polynomials	**Basic:** 5, 15, 27, 45, 61 **Proficient:** 8, 18, 30, 46, 62 **Advanced:** 8, 18, 34, 62, 64

Section 3.4 - Using the Quadratic Formula		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Solve quadratic equations using the Quadratic Formula. • Analyze the discriminant to determine the number and type of solutions. • Solve real-life problems. .	**Cumulative Practice**: transformations of quadratic functions **Prerequisite Skills Practice:** completing the square	**Basic:** 7, 15, 17, 21, 39 **Proficient:** 10, 16, 18, 22, 36 **Advanced:** 16, 18, 26, 38, 65

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

Assessments		
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List of Accommodations and Modifications ● Special Education ● 504 Students ● At Risk Students ● MLL ● Gifted and Talented		

State Mandates and Resources
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PART I: UNIT RATIONALE

<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 1 & 3.5 - Linear & Nonlinear Systems	
Chapter 1 presents topics that were studied in Algebra 1. Students will begin by solving systems of two linear equations, and progress to systems of three equations. Finally, students will use these skills (substitution, eliminations, and graphing) to determine solutions of nonlinear systems.	
Essential Questions	**Learning Targets/Objectives**
1. How can you determine the number of solutions of a linear system? 2. How can you solve a linear system in two variables? 3. How can you solve a linear system in three variables? 4. How can you solve a nonlinear system of equations?	Students will be able to: • Solve systems of two linear equations by substitution and elimination. • Use systems of linear equations to solve real-life problems • Visualize solutions of systems of linear equations in three variables. • Solve systems of linear equations in three variables algebraically. • Solve real-life problems • Solve systems of nonlinear equations. • Solve quadratic equations by graphing.
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
linear equation in two variables, system of two linear equations, solution of a system of two linear equations, ordered pair, substitution method, elimination method, linear equation, quadratic equation, factor	linear equation in three variables, system of three linear equations, solution of a system of three linear equations, ordered triple, system of nonlinear equations

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. A-CED.A.3	1. 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. Climate Change Example: Students may represent constraints describing the economic impact of climate change by equations, inequalities, and/or by systems of inequalities, and interpret solutions as viable or nonviable options.
2. A-REI.C.5	2. 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.
3. A-REI.C.6	3. Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.
4. A-REI.C.7	4. Solve a simple system consisting of a linear equation and a quadratic equation in two variables, algebraically and graphically.
5. A-REI.D.11	5. 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
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
2. HS-PS2-2	2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
3. L.KL.9-10.2.A	3. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level.
4. W.IW.9–10.2	4. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

5. SL.PE.9-10.1.D	5. Respond thoughtfully to various perspectives, summarize points of agreement and disagreement, and justify own views. Make new connections in light of the evidence and reasoning presented.
6. SL.PI.9-10.4	6. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
2020 New Jersey Student Learning Standards for Career Readiness, Life Literacies, and Key Skills	
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4. 9.4.12.CI.1	4. Demonstrate the ability to reflect, analyze, and use creative skills and ideas
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1. 8.1.12.DA.1	1. Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
2. 8.1.12.DA.2	2. Describe the trade-offs in how and where data is organized and stored.

The 8 Mathematical Practices are embedded throughout the course and are evident in daily lessons, assignments, activities, assessments, and projects:

Make sense of problems and persevere in solving them: Take time to analyze the given information and what the problem is asking to help you to plan a solution pathway. Throughout the unit students are given problems that require them to:

- Explain the Meaning
- Find Entry Points
- Analyze Givens
- Interpret a Solution
- Make a Plan
- Consider Similar Problems
- Check Progress
- Consider Simpler Forms
- Problem Solve

Reason abstractly and quantitatively: Investigate specific examples and represent them symbolically, and observe the relationships in numbers or symbols to derive conclusions about a concrete instance. Throughout the unit students are given problems that require them to:

- Make Sense of Quantities
- Use Equations
- Use Expressions
- Understand Quantities
- Use Operations
- Contextualize
- Relationships
- Reason Abstractly

Construct viable arguments and critique the reasoning of others: Make and justify conclusions and decide whether others' arguments are correct or flawed. Throughout the unit students are given problems that require them to:

- Use Assumptions
- Use Defi nitions
- Use Prior Results
- Make Conjectures
- Build Arguments
- Analyze Conjectures
- Use Counterexamples

- Justify Conclusions
- Compare Arguments
- Construct Arguments
- Listen and Ask Questions
- Critique Reasoning
- Use Logic
- Error Analysis

Model with mathematics: Apply the mathematics to a real-life problem, and you interpret mathematical results in the context of the situation. Throughout the unit students are given problems that require them to:

- Apply Mathematics
- Simplify a Solution
- Use a Diagram
- Use a Table
- Use a Graph
- Use a Formula
- Analyze Relationships
- Interpret Results
- Model Real Life

Use appropriate tools strategically: Know what tools are available and think about how each tool might help solve a mathematical problem. Use a tool for its advantages, while being aware of its limitations. Throughout the unit students are given problems that require them to:

- Choose Tools
- Recognize Usefulness of Tools
- Use Other Resources
- Use Technology to Explore

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- Communicate Precisely
- Use Clear Definitions
- State the Meaning of Symbols
- Specify Units
- Label Axes
- Calculate Accurately
- Understand Mathematical Terms

Look for and make use of structure: Look closely to see structure within a mathematical statement, or step back for an overview to see how individual parts make one single object. Throughout the unit students are given problems that require them to:

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- Look for Structure

Look for and express regularity in repeated reasoning: Notice patterns and make generalizations. Keeping in mind the goal of a problem helps you evaluate reasonableness of answers along the way. Throughout the unit students are given problems that require them to:

- Repeat Calculations
- Find General Methods
- Maintain Oversight
- Evaluate Results

Resources

Textbook

Algebra 2, A Common Core Curriculum – Big Ideas Math, Big Ideas Learning LLC., 2019

Online Resources

- BigIdeas Math
- Desmos Activities
- Pear Assessment
- IXL
- Quizizz
- EdPuzzle
- Canva
- Khan Academy
- Inside Mathematics
- NJDOE Digital Item Library
- New Jersey Center for Teaching and Learning
- New Jersey Climate Education Hub

Videos

- Solve systems of two equations using elimination
- Solve systems of three equations
- Nonlinear systems of equations

Integrated Technology

- Google Suite: Google Classroom, Docs, Drive, Mail, etc...
- Big Ideas online program
- Devices:
    - Chromebooks
    - Texas Instrument TI-84 Plus Graphing Calculator

ML Resources
• Multi-Language Glossary
Gifted & Talented Resources
• Leveled Assessments • Enrichment worksheets

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills?

Solving 2x2 Linear Systems Algebraically		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Solve systems of two linear equations by substitution and elimination. • Use systems of linear equations to solve real-life problems	**Cumulative Practice**: Graph two linear equations on the same coordinate plane **Prerequisite Skills Practice:** Solve quadratic equations	Teacher created worksheet

Section 1.4 - Solving Linear Systems		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Visualize solutions of systems of linear equations in three variables. • Solve systems of linear equations in three variables algebraically. • Solve real-life problems	**Cumulative Practice**: solving nonlinear systems by graphing **Prerequisite Skills Practice:** verifying solutions to linear equations	**Basic:** 7, 11, 15, 19, 23 **Proficient:** 8, 12, 14, 24, 30 **Advanced:** 8, 12, 18, 30, 36

Section 3.5 - Solving Nonlinear Systems		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Solve systems of nonlinear equations. • Solve quadratic equations by graphing.	**Cumulative Practice**: graphing a quadratic function in standard form **Prerequisite Skills Practice:** solving systems of linear equations by substitution	**Basic:** 5, 15, 17, 29, 45 **Proficient:** 6, 18, 22, 28, 44 **Advanced:** 10, 18, 22, 30, 46

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

<table>
<tr><th colspan="3">Assessments</th></tr>
<tr><th>Summative</th><th>Formative</th><th>Performance</th></tr>
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<td>The following assessments will be used to evaluate student learning, skill acquisition and academic achievement of the Standards of Mathematical Practice and the New Jersey Learning Standards for Mathematics listed under each chapter in the Algebra 1 curriculum/syllabus at the conclusion of an instructional time period.

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● Chapter Tests
● Periodic Benchmark Tests
● Standardized Tests</td>
<td>The effectiveness of the instructional program will be based on numerous activities and strategies including the following and are not limited to:

● Teacher observations
● Self-Assessments
● Student record-keeping
● Quizzes
● Warm-ups
● Exit Tickets
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● Independent practice</td>
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State Mandates and Resources
● New Jersey Student Learning Standards ● Standards for Mathematical Practices

Black Horse Pike Regional School District

Where inspiring excellence is our standard, and student achievement is the result.

Algebra 2 Honors
Course Number: 033100

Updated: June 2024

PART I: UNIT RATIONALE

<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 4 - Polynomial Functions

Polynomial functions are defined and graphed. End behavior of even and odd. This is the longest chapter in the book, with nine lessons about polynomial functions. Linear and quadratic functions are two types of polynomials, so connections to earlier work are easily made. In the first lesson, polynomial functions are defined and graphed. The notation and vocabulary can be overwhelming for students, though some of the vocabulary was used in Algebra 1. End behavior of even- and odd-degree polynomials is explored. Operations on polynomial expressions are presented so that polynomial expressions can be factored. Prior work with factoring is extended to third- and fourth-degree expressions. Synthetic division is used to efficiently check for possible rational roots when rewriting polynomials in factored form in order to solve polynomial equations. All of the work with operations on polynomials, factoring, and solving leads to the Fundamental Theorem of Algebra in the middle of the chapter: If f(x) is a polynomial of degree n, where n < t; 0, then the equation f(x) = 0 has at least one solution in the set of complex numbers. The corollary to the theorem, namely that an nth-degree polynomial function has exactly n zeros, is the focus of the lesson. The last third of the chapter deals with polynomial functions, in particular the graphs of these functions Concepts that are foundational for work in calculus are presented. Certainly a great deal of content in this chapter is calculator dependent. In fact, symbolic manipulators can perform much of the work presented in the early part of the chapter, and graphing calculators can be used to quickly solve polynomial equations.

Essential Questions	Learning Targets/Objectives
1. What are some common characteristics of the graphs of cubic and quartic polynomial functions? 2. How can you cube a binomial? 3. How can you use the factors of a cubic polynomial to solve a	Students will be able to: • Identify polynomial functions. • Graph polynomial functions using tables and end behavior. • Add and subtract polynomials. • Multiply polynomials.

division problem involving the polynomial? 4. How can you factor a polynomial? 5. How can you determine whether a polynomial equation has a repeated solution? 6. How can you determine whether a polynomial equation has imaginary solutions? 7. How many turning points can the graph of a polynomial function have?	• Use Pascal's Triangle to expand binomials. • Use synthetic division to divide polynomials by binomials of the form $x - k$. • Use the Remainder Theorem. • Factor polynomials. • Use the Factor Theorem. • Find solutions of polynomial equations and zeros of polynomial functions. • Use the Rational Root Theorem. • Use the Irrational Conjugates Theorem • Use the Fundamental Theorem of Algebra. • Find conjugate pairs of complex zeros of polynomial functions. • Use x-intercepts to graph polynomial functions. • Use the Location Principle to identify zeros of polynomial functions. • Find turning points and identify local maximums and local minimums of graphs of polynomial functions. • Identify even and odd functions.
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
monomial, linear function, quadratic function, like terms, remainder, factor by grouping, quadratic form, roots of an equation, real numbers, conjugates, imaginary number, complex solution, solution of an equation, zero of a function, degree of a polynomial, increasing, decreasing, symmetric about the y-axis, local maximum, local minimum	polynomial, polynomial function, end behavior, Pascal's Triangle, polynomial long division, synthetic division, complex conjugates, repeated solution, even function, odd function

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. N-CN.C.8	1. Extend polynomial identities to the complex numbers.
2. N-CN.C.9	2. Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
3. A-APR.A.1	3. 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.
4. A-APR.B.2	4. 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).
5. A-APR.B.3	5. 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.
6. A-APR.C.4	6. Prove polynomial identities and use them to describe numerical relationships.
7. A-APR.C.5	7. 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.
8. A-APR.D.6	8. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + 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.
9. A-SSE.A.2	9. Use the structure of an expression to identify ways to rewrite it.
10. F-BF.B.3	10. 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.
11. F-IF.B.4	11. 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.

12. F-IF.C.7c	12. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
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Videos

- Pascal's Triangle
- Dividing polynomials using Synthetic Division
- Possible number of real roots for polynomials

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- Big Ideas online program
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  - Texas Instrument TI-84 Plus Graphing Calculator

ML Resources

- Multi-Language Glossary

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- Leveled Assessments
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PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills?

Section 4.1 - Graphing Polynomial Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Identify polynomial functions. • Graph polynomial functions using tables and end behavior	**Cumulative Practice**: graphing transformations of quadratic functions **Prerequisite Skills Practice:** evaluating functions	**Basic:** 5, 13, 19, 27, 41 **Proficient:** 6, 14, 20, 30, 41 **Advanced:** 8, 16, 20, 32, 41

Section 4.2 - Adding, Subtracting, and Multiplying Polynomials		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Add and subtract polynomials. • Multiply polynomials. • Use Pascal's Triangle to expand binomials.	**Cumulative Practice**: writing equations of parabolas **Prerequisite Skills Practice:** simplifying expressions	**Basic:** 5, 11, 19, 37, 43 **Proficient:** 8, 12, 22, 40, 44 **Advanced:** 8, 12, 34, 40, 48

Section 4.3 - Dividing Polynomials		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Use synthetic division to divide polynomials by binomials of the form $x - k$. • Use the Remainder Theorem.	**Cumulative Practice**: solving three variable systems of equations **Prerequisite Skills Practice:** factoring trinomials	**Basic:** 7, 11, 13, 25, 31 **Proficient:** 8, 12, 14, 28, 32 **Advanced:** 10, 16, 18, 32, 36

Section 4.4 - Factoring Polynomials		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Factor polynomials. • Use the Factor Theorem	**Cumulative Practice**: graphing quadratic functions in intercept form **Prerequisite Skills Practice:** factoring quadratics	**Basic:** 9, 15, 25, 35, 49 **Proficient:** 10, 18, 26, 36, 50 **Advanced:** 30, 38, 42, 50, 56

Section 4.5 - Solving Polynomial Equations		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Find solutions of polynomial equations and zeros of polynomial functions. • Use the Rational Root Theorem. • Use the Irrational Conjugates Theorem.	**Cumulative Practice**: solving equations by factoring **Prerequisite Skills Practice:** solving two-step linear equations	**Basic:** 5, 13, 25, 37, 41 **Proficient:** 12, 18, 30, 38, 44 **Advanced:** 12, 20, 32, 38, 46

Section 4.6 - The Fundamental Theorem of Algebra		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Use the Fundamental Theorem of Algebra. • Find conjugate pairs of complex zeros of polynomial functions	**Cumulative Practice**: writing quadratic equations in vertex form **Prerequisite Skills Practice:** identifying the degree of polynomials	**Basic:** 7, 9, 15, 21, 33 **Proficient:** 8, 14, 20, 26, 36 **Advanced:** 8, 16, 28, 40, 44

Section 4.8 - Analyzing Graphs of Polynomial Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Use x-intercepts to graph polynomial functions. • Use the Location Principle to identify zeros of polynomial functions. • Find turning points and identify local maximums and local minimums of graphs of polynomial functions.	**Cumulative Practice**: solving quadratic equations by completing the square **Prerequisite Skills Practice:** finding the vertex of a quadratic function	**Basic:** 3, 7, 19, 27, 41 **Proficient:** 4, 12, 20, 28, 44 **Advanced:** 6, 14, 20, 30, 46

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

Assessments		
Summative	**Formative**	**Performance**
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List of Accommodations and Modifications ● Special Education ● 504 Students ● At Risk Students ● MLL ● Gifted and Talented		

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Algebra 2 Honors
Course Number: 033100

Updated: June 2024

PART I: UNIT RATIONALE

<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 5 - Rational Exponents and Radical Functions

In this unit (Chapter 5) the first part introduces radicals and nth roots and how these may be written as rational exponents. A connection is made to the properties of exponents studied in Algebra 1, noting that now exponents can be rational numbers and are no longer restricted to being nonzero integers. In the middle portion of the chapter, radical expressions, also written in rational exponent form, are represented as functions and are graphed. This leads to a look at what the domains are for each function type. The graphs of radical functions are used to help students think about solutions of radical equations and inequalities. Certainly, one goal is for students to recognize that solving radical equations is an extension of solving other types of functions. The difference, however, is that sometimes extraneous solutions are introduced when solving radical equations, so it is necessary to check apparent solutions. The last lessons in the chapter involve performing the four basic operations on functions and doing so from multiple approaches: symbolic, numerical, and graphical. The last lesson introduces inverse functions—finding the inverse of linear, simple polynomial, and radical functions, and noting that the graphs of inverse functions are reflections in the line y = x.

Essential Questions	Learning Targets/Objectives
1. How can you use a rational exponent to represent a power involving a radical? 2. How can you use properties of exponents to simplify products and quotients of radicals? 3. How can you identify the domain and range of a radical function?	Students will be able to: • Find nth roots of numbers. • Evaluate expressions with rational exponents. • Solve equations using nth roots. • Use properties of rational exponents to simplify expressions with rational exponents. • Use properties of radicals to simplify and write radical expressions in simplest form.

4. How can you solve a radical equation? 5. How can you use the graphs of two functions to sketch the graph of an arithmetic combination of the two functions? 6. How do you compose functions? 7. How can you sketch the graph of the inverse of a function?	• Graph radical functions. • Write transformations of radical functions. • Graph parabolas and circles. • Solve equations containing radicals and rational exponents. • Solve radical inequalities. • Add, subtract, multiply, and divide functions • Composition of functions • Explore inverses of functions. • Find and verify inverses of nonlinear functions. • Solve real-life problems using inverse functions
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
Product of Powers Property, Quotient of Powers Property, Power of a Power Property, Power of a Quotient Property, square root, cube root, exponent, properties of integer exponents, absolute value, transformations, parabola, circle, radical expressions, solving quadratic equations, domain, scientific notation, combining like terms, substitution, input, output, inverse operations, reflection, line of reflection	nth root of a, index of a radical, rationalizing the denominator, simplest form of a radical, conjugate, like radicals, radical function, radical equation, extraneous solutions, rational exponents, composition of functions, inverse functions

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. N-RN.A.1	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.
2. N-RN.A.2	2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.
3. N-RN.A.3	3. Simplify radicals, including algebraic radicals

4. A-CED.A.4	4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
5. A-REI.A.1	5. 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.
6. A-REI.A.2	6. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
7. F-BF.A.1b	7. Combine standard function types using arithmetic operations.
8. F-BF.A.1c	8. Compose functions.
9. F-BF.B.3	9. 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.
10. F-BF.4a	10. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse.
11. F-IF.C.7b	11. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
2. HS-PS2-2	2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
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5. SL.PE.9-10.1.D	5. Respond thoughtfully to various perspectives, summarize points of agreement and disagreement, and justify own

	views. Make new connections in light of the evidence and reasoning presented.
6. SL.PI.9-10.4	6. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
2020 New Jersey Student Learning Standards for Career Readiness, Life Literacies, and Key Skills	
1. 9.1.12.CDM.1	1. Identify the purposes, advantages, and disadvantages of debt.
2. 9.1.12.CDM.8	2. Compare and compute interest and compound interest and develop an amortization table using business tools.
3. 9.4.12.IML.3	3. Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
4. 9.4.12.CI.1	4. Demonstrate the ability to reflect, analyze, and use creative skills and ideas
2020 New Jersey Student Learning Standards for Computer Science and Design Thinking	
1. 8.1.12.DA.1	1. Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
2. 8.1.12.DA.2	2. Describe the trade-offs in how and where data is organized and stored.

The 8 Mathematical Practices are embedded throughout the course and are evident in daily lessons, assignments, activities, assessments, and projects:

Make sense of problems and persevere in solving them: Take time to analyze the given information and what the problem is asking to help you to plan a solution pathway. Throughout the unit students are given problems that require them to:

- Explain the Meaning
- Find Entry Points
- Analyze Givens
- Interpret a Solution
- Make a Plan
- Consider Similar Problems
- Check Progress
- Consider Simpler Forms
- Problem Solve

Reason abstractly and quantitatively: Investigate specific examples and represent them symbolically, and observe the relationships in numbers or symbols to derive conclusions about a concrete instance. Throughout the unit students are given problems that require them to:

- Make Sense of Quantities
- Use Equations
- Use Expressions
- Understand Quantities
- Use Operations
- Contextualize
- Relationships
- Reason Abstractly

Construct viable arguments and critique the reasoning of others: Make and justify conclusions and decide whether others' arguments are correct or flawed. Throughout the unit students are given problems that require them to:

- Use Assumptions
- Use Defi nitions
- Use Prior Results
- Make Conjectures
- Build Arguments
- Analyze Conjectures
- Use Counterexamples

- Justify Conclusions
- Compare Arguments
- Construct Arguments
- Listen and Ask Questions
- Critique Reasoning
- Use Logic
- Error Analysis

Model with mathematics: Apply the mathematics to a real-life problem, and you interpret mathematical results in the context of the situation. Throughout the unit students are given problems that require them to:

- Apply Mathematics
- Simplify a Solution
- Use a Diagram
- Use a Table
- Use a Graph
- Use a Formula
- Analyze Relationships
- Interpret Results
- Model Real Life

Use appropriate tools strategically: Know what tools are available and think about how each tool might help solve a mathematical problem. Use a tool for its advantages, while being aware of its limitations. Throughout the unit students are given problems that require them to:

- Choose Tools
- Recognize Usefulness of Tools
- Use Other Resources
- Use Technology to Explore

Attend to precision: Develop a habit of being careful how you talk about concepts, label your work, and write your answers. Throughout the unit students are given problems that require them to:

- Communicate Precisely
- Use Clear Definitions
- State the Meaning of Symbols
- Specify Units
- Label Axes
- Calculate Accurately
- Understand Mathematical Terms

Look for and make use of structure: Look closely to see structure within a mathematical statement, or step back for an overview to see how individual parts make one single object. Throughout the unit students are given problems that require them to:

- View as Components
- Look for Patterns
- Look for Structure

Look for and express regularity in repeated reasoning: Notice patterns and make generalizations. Keeping in mind the goal of a problem helps you evaluate reasonableness of answers along the way. Throughout the unit students are given problems that require them to:

- Repeat Calculations
- Find General Methods
- Maintain Oversight
- Evaluate Results

Resources

Textbook

Algebra 2, A Common Core Curriculum – Big Ideas Math, Big Ideas Learning LLC., 2019

Online Resources

- BigIdeas Math
- Desmos Activities
- Pear Assessment
- IXL
- Quizizz
- EdPuzzle
- Canva
- Khan Academy
- Inside Mathematics
- NJDOE Digital Item Library
- New Jersey Center for Teaching and Learning
- New Jersey Climate Education Hub

Videos

- Rational Exponents
- Solving radical equations: One solution
- Solving radical equations: Two solutions
- Solving radical equations: No solution
- Finding Composition of Functions

Integrated Technology

- Google Suite: Google Classroom, Docs, Drive, Mail, etc...
- Big Ideas online program
- Devices:
  - Chromebooks
  - Texas Instrument TI-84 Plus Graphing Calculator

ML Resources

- Multi-Language Glossary

Gifted & Talented Resources

- Leveled Assessments
- Enrichment worksheets

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills?

Section 5.1 - nth Roots and Rational Exponents		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Find nth roots of numbers. • Evaluate expressions with rational exponents. • Solve equations using nth roots.	**Cumulative Practice**: writing equations of parabolas **Prerequisite Skills Practice:** writing equations of parabolas	**Basic:** 7, 13, 29, 31, 41 **Proficient:** 8, 16, 30, 42, 46 **Advanced:** 10, 18, 32, 44, 46

Section 5.2 - Properties of Rational Exponents and Radicals		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Use properties of rational exponents to simplify expressions with rational exponents. • Use properties of radicals to simplify and write radical expressions in simplest form	**Cumulative Practice**: using the Quadratic Formula to solve equations **Prerequisite Skills Practice:** using the quotient of powers property to simplify expressions	**Basic:** 5, 15, 31, 59, 65 **Proficient:** 8, 18, 34, 60, 68 **Advanced:** 12, 20, 36, 62, 70

Section 5.3 - Graphing Radical Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Graph radical functions. • Write transformations of radical functions. • Graph parabolas and circles	**Cumulative Practice**: solving a nonlinear system by graphing **Prerequisite Skills Practice:** graphing transformations of quadratic functions	**Basic:** 11, 19, 39, 41, 51 **Proficient:** 14, 22, 39, 42, 58 **Advanced:** 16, 26, 39, 44, 62

Section 5.4 - Solving Radical Equations and Inequalities		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Solve equations containing radicals and rational exponents. • Solve radical inequalities.	**Cumulative Practice**: solving quadratic inequalities **Prerequisite Skills Practice:** using the Triangle Inequality Theorem	**Basic:** 5, 13, 17, 27, 41 **Proficient:** 6, 14, 22, 32, 42 **Advanced:** 10, 13, 26, 34, 44

Section 5.5 - Performing Function Operations		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Add, subtract, multiply, and divide functions	**Cumulative Practice**: writing a quadratic equation in vertex form **Prerequisite Skills Practice:** simplifying exponential expressions	**Basic:** 5, 7, 9, 13, 19 **Proficient:** 6, 8, 10, 14, 20 **Advanced:** 6, 10, 12, 16, 20

Supplement - Composition of Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Perform a composition of functions	**Cumulative Practice**: expand a binomial using Pascals Triangle **Prerequisite Skills Practice:** simplifying exponential expressions	Teacher created worksheet

Section 5.6 - Inverse of a Function		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Explore inverses of functions. • Find and verify inverses of nonlinear functions. • Solve real-life problems using inverse functions.	**Cumulative Practice**: solving quadratic equations using square roots **Prerequisite Skills Practice:** graphing transformations of square root functions	**Basic:** 9, 13, 23, 37, 49 **Proficient:** 10, 18, 26, 44, 50 **Advanced:** 12, 20, 28, 46, 52

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

Assessments		
Summative	**Formative**	**Performance**
The following assessments will be used to evaluate student learning, skill acquisition and academic achievement of the Standards of Mathematical Practice and the New Jersey Learning Standards for Mathematics listed under each chapter in the Algebra 1 curriculum/syllabus at the conclusion of an instructional time period. ● Diagnostic Pre-Test ● Chapter Tests ● Periodic Benchmark Tests ● Standardized Tests	The effectiveness of the instructional program will be based on numerous activities and strategies including the following and are not limited to: ● Teacher observations ● Self-Assessments ● Student record-keeping ● Quizzes ● Warm-ups ● Exit Tickets ● Participation in class discussions ● Independent practice	The following assessments require students to utilize various strands of mathematics. ● Projects ● Performance Tasks ● Homework ● Classwork
List of Accommodations and Modifications ● Special Education ● 504 Students ● At Risk Students ● MLL ● Gifted and Talented		

State Mandates and Resources
● New Jersey Student Learning Standards ● Standards for Mathematical Practices

Black Horse Pike Regional School District

Where inspiring excellence is our standard, and student achievement is the result.

Algebra 2 Honors
Course Number: 033100

Updated: June 2024

PART I: UNIT RATIONALE

<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 6 - Exponential and Logarithmic Functions

In this unit (Chapter 6) two new types of functions are presented, exponential and logarithmic. The natural base e, an irrational number, is introduced in the second lesson. Students write and graph exponential functions for base e and other bases. Compound interest and continuous compounding are two of the many applications explored. The logarithmic function, which is the inverse of the exponential function, is introduced, and the connection to properties of exponents is made. In addition, transformations of the graphs of both functions are presented in the middle of the chapter. The last part of the chapter looks at solving exponential and logarithmic equations using different approaches: analytical, numerical, and graphical.

Essential Questions	Learning Targets/Objectives
1. What is the natural base e? 2. What are some of the characteristics of the graph of a logarithmic function? 3. How can you transform the graphs of exponential and logarithmic functions? 4. How can you use properties of exponents to derive properties of logarithms? 5. How can you solve exponential and logarithmic equations?	Students will be able to: • Define and use the natural base e. • Graph natural base functions. • Solve real-life problems. • Define and evaluate logarithms. • Use inverse properties of logarithmic and exponential functions. • Graph logarithmic functions. • Transform graphs of exponential functions. • Transform graphs of logarithmic functions. • Write transformations of graphs of exponential and logarithmic functions.

	• Use the properties of logarithms to evaluate logarithms. • Use the properties of logarithms to expand or condense logarithmic expressions. • Use the change-of-base formula to evaluate logarithms. • Solve exponential equations. • Solve logarithmic equations. • Solve exponential and logarithmic inequalities.
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
domain, range, exponential function, irrational number, properties of exponents, percent increase, percent decrease, compound interest, inverse functions, transformations, base, properties of exponents, : extraneous solution	natural base e, logarithm of y with base b function, common logarithm, natural logarithm

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. A-REI.A.1	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. A-SSE.A.2	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).
3. F-BF.B.3	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. F-BF.B.4a	4. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse.
5. F-IF.C.7e	5. Graph exponential and logarithmic functions, showing intercepts and end behavior.
6. F-LE.A.4	6. Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to ab^(ct) = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
7. F-LE.B.5	7. Interpret the parameters in a linear or exponential function in terms of a context.
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
2. HS-PS2-2	2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
3. L.KL.9-10.2.A	3. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level.
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5. SL.PE.9-10.1.D	5. Respond thoughtfully to various perspectives, summarize points of agreement and disagreement, and justify own views. Make new connections in light of the evidence and reasoning presented.
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- Maintain Oversight
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Resources

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- NJDOE Digital Item Library
- New Jersey Center for Teaching and Learning
- New Jersey Climate Education Hub

Videos

- Solving exponential equations
- Logarithmic Equations

Integrated Technology

- Google Suite: Google Classroom, Docs, Drive, Mail, etc...
- Big Ideas online program
- Devices:
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    - Texas Instrument TI-84 Plus Graphing Calculator

ML Resources
• Multi-Language Glossary
Gifted & Talented Resources
• Leveled Assessments • Enrichment worksheets

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills?

Section 6.2 - The Natural Base e		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Defi ne and use the natural base e. • Graph natural base functions. • Solve real-life problems.	**Cumulative Practice**: modeling with linear functions **Prerequisite Skills Practice:** : identifying exponential growth and decay functions	**Basic:** 3, 7, 15, 19, 35 **Proficient:** 8, 14, 18, 20, 35 **Advanced:** 10, 14, 20, 36, 41

Section 6.3 - Logarithms and Logarithmic Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Define and evaluate logarithms. • Use inverse properties of logarithmic and exponential functions. • Graph logarithmic functions	**Cumulative Practice**: finding the inverse of nonlinear functions **Prerequisite Skills Practice:** solving equations using properties of exponents	**Basic:** 11, 17, 37, 45, 55 **Proficient:** 14, 20, 40, 50, 58 **Advanced:** 16, 22, 40, 52, 60

Section 6.4 - Transformations of Exponential and Logarithmic Functions		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Transform graphs of exponential functions. • Transform graphs of logarithmic functions. • Write transformations of graphs of exponential and logarithmic functions.	**Cumulative Practice**: writing an equation of a parabola **Prerequisite Skills Practice:** describing transformations of polynomials	**Basic:** 7, 19, 27, 35, 39 **Proficient:** 10, 20, 28, 36, 42 **Advanced:** 14, 22, 30, 38, 42

Section 6.5 - Properties of Logarithms		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Use the properties of logarithms to evaluate logarithms. • Use the properties of logarithms to expand or condense logarithmic expressions. • Use the change-of-base formula to evaluate logarithms	**Cumulative Practice**: translating a polynomial function **Prerequisite Skills Practice:** solving exponential equations	**Basic:** 5, 15, 23, 33, 43 **Proficient:** 6, 16, 28, 38, 43 **Advanced:** 8, 18, 30, 40, 43

Section 6.6 - Solving Exponential and Logarithmic Equations		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
● Solve exponential equations. ● Solve logarithmic equations. ● Solve exponential and logarithmic inequalities.	**Cumulative Practice**: solving radical equations **Prerequisite Skills Practice:** simplifying logarithmic expressions	**Basic:** 5, 19, 21, 33, 47 **Proficient:** 10, 20, 26, 36, 52 **Advanced:** 16, 20, 30, 38, 54

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

Assessments		
Summative	**Formative**	**Performance**
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Algebra 2 Honors
Course Number: 033100

Updated: June 2024

PART I: UNIT RATIONALE

<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 7 - Rational Functions

In this unit (Chapter 7) introduces rational functions, a new type of function for students to work with. The graphs of rational functions are presented in the second section. Students learn to identify the horizontal and vertical asymptotes by inspecting the equations. Simple transformations of rational functions are also performed. There are two sections on operations with rational functions. Connections are made to operations with fractions, and symbolic manipulation skills are necessary to perform the operations. Although the approach is primarily analytical, graphs are used to confirm that operations have been performed correctly. The chapter ends with a look at solving rational equations. Many of the techniques used to solve proportions are also used to solve rational equations.

Essential Questions	Learning Targets/Objectives
1. What are some of the characteristics of the graph of a rational function? 2. How do you graph a rational function? 3. What graphical characteristics does a rational function have? 4. How can you determine the excluded values in a product or quotient of two rational expressions? 5. How can you determine the domain of the sum or difference of two rational expressions?	Students will be able to: • Graph simple rational functions. • Translate simple rational functions.. • Algebraically determine the domain of a rational function. • Determine horizontal and vertical asymptotes of a rational function. • Determine where a rational function has holes. • Graph rational functions • Determine the domain and range of a rational function when graphed. • Simplify rational expressions.

6. How can you solve a rational equation?	• Multiply rational expressions. • Divide rational expressions. • Add or subtract rational expressions. • Rewrite rational expressions and graph the related function. • Simplify complex fractions. • Solve rational equations by cross multiplying. • Solve rational equations by using the least common denominator. • Use inverses of functions.
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
domain, range, domain restriction, fractions, polynomials, domain, equivalent expressions, reciprocal, rational numbers, proportion, extraneous solution, inverse of a function	rational function , vertical asymptote, horizontal asymptote, hole, rational expression, simplified form of a rational expression, complex fraction, cross multiplying

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. A-APR.D.6	1. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + 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.
2. A-APR.D.7	2. Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
3. A-REI.A.1	3. 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.

4. A-REI.A.2	4. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
5. F-BF.B.3	5. 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.
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration
2. HS-PS2-2	2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
3. L.KL.9-10.2.A	3. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level.
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2020 New Jersey Student Learning Standards for Computer Science and Design Thinking	

1. 8.1.12.DA.1 2. 8.1.12.DA.2	1. Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change. 2. Describe the trade-offs in how and where data is organized and stored.

The 8 Mathematical Practices are embedded throughout the course and are evident in daily lessons, assignments, activities, assessments, and projects:

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- Find Entry Points
- Analyze Givens
- Interpret a Solution
- Make a Plan
- Consider Similar Problems
- Check Progress
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- Problem Solve

Reason abstractly and quantitatively: Investigate specific examples and represent them symbolically, and observe the relationships in numbers or symbols to derive conclusions about a concrete instance. Throughout the unit students are given problems that require them to:

- Make Sense of Quantities
- Use Equations
- Use Expressions
- Understand Quantities
- Use Operations
- Contextualize

- Relationships
- Reason Abstractly

Construct viable arguments and critique the reasoning of others: Make and justify conclusions and decide whether others' arguments are correct or flawed. Throughout the unit students are given problems that require them to:

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- Use Defi nitions
- Use Prior Results
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- Analyze Conjectures
- Use Counterexamples
- Justify Conclusions
- Compare Arguments
- Construct Arguments
- Listen and Ask Questions
- Critique Reasoning
- Use Logic
- Error Analysis

Model with mathematics: Apply the mathematics to a real-life problem, and you interpret mathematical results in the context of the situation. Throughout the unit students are given problems that require them to:

- Apply Mathematics
- Simplify a Solution
- Use a Diagram
- Use a Table
- Use a Graph
- Use a Formula
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- Interpret Results
- Model Real Life

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- Evaluate Results

Resources

Textbook

Algebra 2, A Common Core Curriculum – Big Ideas Math, Big Ideas Learning LLC., 2019

Online Resources

- BigIdeas Math
- Desmos Activities
- Pear Assessment
- IXL
- Quizizz
- EdPuzzle
- Canva
- Khan Academy
- Inside Mathematics
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- New Jersey Center for Teaching and Learning
- New Jersey Climate Education Hub

Videos

-

Integrated Technology

- Google Suite: Google Classroom, Docs, Drive, Mail, etc...
- Big Ideas online program
- Devices:
  - Chromebooks
  - Texas Instrument TI-84 Plus Graphing Calculator

ML Resources

• Multi-Language Glossary
Gifted & Talented Resources
• Leveled Assessments • Enrichment worksheets

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

<u>How</u> will students uncover content and build skills?

Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
•	**Cumulative Practice**: verifying solutions to equations **Prerequisite Skills Practice:** simplifying numerical expressions	**Basic:** 9, 11, 15, 27, 29 **Proficient:** 14, 16, 28, 34, 43 **Advanced:** 15, 16, 20, 34, 46

Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
	Cumulative Practice: solving equations **Prerequisite Skills Practice:** simplifying expressions	**Basic:** 3, 9, 13, 15, 21 **Proficient:** 10, 14, 16, 22, 37 **Advanced:** 6, 16, 20, 35, 44

Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
	Cumulative Practice: solving a two-step equation	**Basic:** 9, 15, 19, 21, 23 **Proficient:** 8, 18, 20, 22, 24

	Prerequisite Skills Practice: using the distributive property to simplify expressions	**Advanced:** 18, 24, 30, 32, 36

Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
	Cumulative Practice: using complementary and supplementary angles to find a missing value **Prerequisite Skills Practice:** comparing absolute value	**Basic:** 19, 21, 23, 25, 37 **Proficient:** 20, 22, 24, 26, 38 **Advanced:** 21, 24, 26, 30, 40

Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
	Cumulative Practice: using the Pythagorean Theorem **Prerequisite Skills Practice:** solving equations	**Basic:** 7, 17, 23, 27, 31 **Proficient:** 12, 22, 30, 32, 34 **Advanced:** 12, 22, 35, 37, 40

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

Assessments

Summative	Formative	Performance
The following assessments will be used to evaluate student learning, skill acquisition and academic achievement of the Standards of Mathematical Practice and the New Jersey Learning Standards for Mathematics listed under each chapter in the Algebra 1 curriculum/syllabus at the conclusion of an instructional time period. ● Diagnostic Pre-Test ● Chapter Tests ● Periodic Benchmark Tests ● Standardized Tests	The effectiveness of the instructional program will be based on numerous activities and strategies including the following and are not limited to: ● Teacher observations ● Self-Assessments ● Student record-keeping ● Quizzes ● Warm-ups ● Exit Tickets ● Participation in class discussions ● Independent practice	The following assessments require students to utilize various strands of mathematics. ● Projects ● Performance Tasks ● Homework ● Classwork

List of Accommodations and Modifications

- Special Education
- 504 Students
- At Risk Students
- MLL
- Gifted and Talented

State Mandates and Resources

- New Jersey Student Learning Standards
- Standards for Mathematical Practices

Black Horse Pike Regional School District

Where inspiring excellence is our standard, and student achievement is the result.

Algebra 2 Honors
Course Number: 033100

Updated: June 2024

PART I: UNIT RATIONALE

<u>WHY</u> ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Chapter 8 - Sequences and Series	
This chapter introduces arithmetic and geometric sequences followed by adding terms of a sequence. Partial sums and sums of infinite arithmetic and geometric series are explored numerically.	
Essential Questions	**Learning Targets/Objectives**
1. How can you write a rule for the nth term of a sequence? 2. How can you recognize an arithmetic sequence from its graph? 3. How can you recognize a geometric sequence from its graph? 4. How can you find the sum of an infinite geometric series? 5. How can you define a sequence recursively?	Students will be able to: • Use sequence notation to write terms of sequences. • Write a rule for the nth term of a sequence. • Sum the terms of a sequence to obtain a series and use summation notation. • Identify arithmetic sequences. • Write rules for arithmetic sequences. • Find sums of finite arithmetic series. • Identify geometric sequences. • Write rules for geometric sequences. • Find sums of finite geometric series. • Find partial sums of infinite geometric series. • Find sums of infinite geometric series. • Evaluate recursive rules for sequences. • Write recursive rules for sequences.

	• Translate between recursive and explicit rules for sequences. • Use recursive rules to solve real-life problems.
Tier 2 Vocabulary *High-frequency words used throughout the unit*	**Tier 3 Vocabulary** *Discipline-specific words used throughout the unit*
domain, range, linear function, mean, exponential function, properties of exponents, repeating decimal, fraction in simplest form, rational number	sequence, terms of a sequence, series, summation notation, sigma notation, arithmetic sequence, common difference, arithmetic series, geometric sequence, common ratio, geometric series, partial sum

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

New Jersey Student Learning Standards That Support Learning Targets	
2023 New Jersey Student Learning Standards for Mathematics	
1. A-SSE.B.4	1. Derive and/or explain the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.
2. F-BF.A.1a	2. Determine an explicit expression, a recursive process, or steps for calculation from a context.
3. F-BF.A.2	3. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
4. F-IF.A.3	4. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
5. F-LE.A.2	5. 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).
NJSLS	**Interdisciplinary Connections**
1. HS-PS2-1	1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration

2. HS-PS2-2	2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
3. L.KL.9-10.2.A	3. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level.
4. W.IW.9–10.2	4. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
5. SL.PE.9-10.1.D	5. Respond thoughtfully to various perspectives, summarize points of agreement and disagreement, and justify own views. Make new connections in light of the evidence and reasoning presented.
6. SL.PI.9-10.4	6. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
2020 New Jersey Student Learning Standards for Career Readiness, Life Literacies, and Key Skills	
1. 9.1.12.CDM.1	1. Identify the purposes, advantages, and disadvantages of debt.
2. 9.1.12.CDM.8	2. Compare and compute interest and compound interest and develop an amortization table using business tools.
3. 9.4.12.IML.3	3. Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
4. 9.4.12.CI.1	4. Demonstrate the ability to reflect, analyze, and use creative skills and ideas
2020 New Jersey Student Learning Standards for Computer Science and Design Thinking	
1. 8.1.12.DA.1	1. Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
2. 8.1.12.DA.2	2. Describe the trade-offs in how and where data is organized and stored.

The 8 Mathematical Practices are embedded throughout the course and are evident in daily lessons, assignments, activities, assessments, and projects:

Make sense of problems and persevere in solving them: Take time to analyze the given information and what the problem is asking to help you to plan a solution pathway. Throughout the unit students are given problems that require them to:

- Explain the Meaning
- Find Entry Points
- Analyze Givens
- Interpret a Solution
- Make a Plan
- Consider Similar Problems
- Check Progress
- Consider Simpler Forms
- Problem Solve

Reason abstractly and quantitatively: Investigate specific examples and represent them symbolically, and observe the relationships in numbers or symbols to derive conclusions about a concrete instance. Throughout the unit students are given problems that require them to:

- Make Sense of Quantities
- Use Equations
- Use Expressions
- Understand Quantities
- Use Operations
- Contextualize
- Relationships
- Reason Abstractly

Construct viable arguments and critique the reasoning of others: Make and justify conclusions and decide whether others' arguments are correct or flawed. Throughout the unit students are given problems that require them to:

- Use Assumptions
- Use Defi nitions
- Use Prior Results
- Make Conjectures
- Build Arguments
- Analyze Conjectures
- Use Counterexamples

- Justify Conclusions
- Compare Arguments
- Construct Arguments
- Listen and Ask Questions
- Critique Reasoning
- Use Logic
- Error Analysis

Model with mathematics: Apply the mathematics to a real-life problem, and you interpret mathematical results in the context of the situation. Throughout the unit students are given problems that require them to:

- Apply Mathematics
- Simplify a Solution
- Use a Diagram
- Use a Table
- Use a Graph
- Use a Formula
- Analyze Relationships
- Interpret Results
- Model Real Life

Use appropriate tools strategically: Know what tools are available and think about how each tool might help solve a mathematical problem. Use a tool for its advantages, while being aware of its limitations. Throughout the unit students are given problems that require them to:

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PART III: TRANSFER OF KNOWLEDGE AND SKILLS

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How will students uncover content and build skills?

Section 8.1 - Defining and Using Sequences and Series		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Use sequence notation to write terms of sequences. • Write a rule for the nth term of a sequence. • Sum the terms of a sequence to obtain a series and use summation notation.	**Cumulative Practice**: solving logarithmic equations **Prerequisite Skills Practice:** evaluating functions	**Basic:** 7, 17, 29, 33, 41 **Proficient:** 10, 18, 30, 36, 46 **Advanced:** 14, 20, 30, 38, 46

Section 8.2 - Analyzing Arithmetic Sequences and Series		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Identify arithmetic sequences. • Write rules for arithmetic sequences. • Find sums of fi nite arithmetic series.	**Cumulative Practice**: finding a sample space **Prerequisite Skills Practice:** solving systems of linear equations	**Basic:** 5, 15, 23, 33, 47 **Proficient:** 8, 18, 26, 34, 50 **Advanced:** 20, 26, 38, 52, 56

Section 8.3 - Analyzing Geometric Sequences and Series		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Identify geometric sequences. • Write rules for geometric sequences. • Find sums of finite geometric series.	**Cumulative Practice**: Solving an exponential equation **Prerequisite Skills Practice:** finding the sum of arithmetic sequences using summation notation	**Basic:** 7, 15, 23, 33, 47 **Proficient:** 20, 26, 40, 48, 58 **Advanced:** 22, 26, 40, 52, 58

Section 8.4 - Finding Sums of Infinite Geometric Series		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Find partial sums of infinite geometric series. • Find sums of infinite geometric series.	**Cumulative Practice**: using the Binomial Theorem **Prerequisite Skills Practice:** finding the sum of geometric sequences in summation notation	**Basic:** 3, 7, 11, 17, 21 **Proficient:** 6, 10, 12, 18, 22 **Advanced:** 6, 10, 14, 18, 24

Section 8.5 - Using Recursive Rules with Sequences		
Specific Learning Objective	**Warm-Up/Starting Options**	**Practice & Apply Exercises**
• Evaluate recursive rules for sequences. • Write recursive rules for sequences. • Translate between recursive and explicit rules for sequences. • Use recursive rules to solve real-life problems	**Cumulative Practice**: solving a rational equation by cross multiplying **Prerequisite Skills Practice:** writing terms of sequences using an explicit rule	**Basic:** 7, 11, 31, 43, 53 **Proficient:** 10, 16, 36, 46, 54 **Advanced:** 10, 20, 38, 48, 54

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