Lakewood School DIstrict Curriculum Guide

Grade: High School	**Content Area: Mathematics - Algebra II**

Original Adoption: 2023 NJSLS English Language Arts and English as a Second Language (8-21-24); Math NJSLS Mathematics (8-21-24); 2020 NJSLS Science, Social Studies, Career Readiness, Life Literacies & Key Skills, Computer Design & Thinking, Visual & Performing Arts, World Language, Comprehensive Health and Physical Education (5-11-22)
Created By:

Recommended Pacing Guide	
Unit 1: Radicals, Imaginary Numbers and Quadratic Equations	19 days
Unit 2: Solve & Graph Quadratic Equations Solve absolute value equations Solve linear systems	21 days
Unit 3: Polynomials	18 days
UNIT 4: FUNCTIONS Domain and Range, Evaluating Functions, Inverse functions, function transformations	33 days
UNIT 5: Radical and Rational Equations and Functions	23 days
UNIT 6: Exponential and Logarithmic Functions	29 days
UNIT 7: Introduction to Trigonometry	25 days
UNIT 8: Graphing Trigonometric Functions	22 days

Alignment with State Mandates

The following colors are used throughout this document to indicate areas in which the curriculum is aligned with the following NJSA requirements:

- Holocaust and genocides (N.J.S.A. 18A:35-28)
- History and contributions of African-Americans (Amistad Law) (N.J.S.A. 18A:35-4.43)
- Highlight and promote diversity and inclusion (Diversity & Inclusion Law) (N.J.S.A. 18A:35-4.36a)
- History of disabled and LGBT persons included in middle and high school curriculum (Section 18A:35-4.35)
- Climate Change - to prepare students to understand how and why climate change happens, the impact it has on our local and global communities and to act in informed and sustainable ways. Please click here for specific examples (by subject).

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Unit 1: Radicals, Imaginary Numbers and Quadratic Equations	19 days
New Jersey Learning Standards-Mathematics	
N.RN.A.1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents
N.RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
N.RN.A.3	Simplify radicals, including algebraic radicals (e.g. $\sqrt[3]{54} = 3\sqrt[3]{2}$, simplify $\sqrt{32x^2}$).
N.CN.A.1	Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
N.CN.A.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
N.CN.C.7	Solve quadratic equations with real coefficients that have complex solutions.
A.REI.A.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Standards of Mathematical Practices	
MP1. Make sense of problems and persevere in solving them	• Find meaning in problems • Look for entry points • Analyze, conjecture and plan solution pathways • Monitor and adjust • Verify answers • Ask themselves the question: "Does this make sense?"
MP2. Reason abstractly and quantitatively.	• Make sense of quantities and their relationships in problems • Learn to contextualized and decontextualized • Create coherent representations of problems
MP3. Construct viable arguments and critique the reasoning of others.	• Understand and use information to construct arguments • Make and explore the truth of conjectures • Recognize and use counterexamples • Justify conclusions and respond to arguments of others

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MP4. Model with Mathematics.	• Apply mathematics to problems in everyday life • Make assumptions and approximations • Identify quantities in a practical situation • Interpret results in the context of the situation and reflect on whether the results make sense
MP5. Use appropriate tools strategically	• Consider the available tools when solving problems • Are familiar with tools appropriate for their grade or course (pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer programs, digital content located on a website, and other technological tools) • Make sound decisions of which of these tools might be helpful
MP6. Attend to precision.	• Communicate precisely to others • Use clear definitions, state the meaning of symbols and are careful about specifying units of measure and labeling axes • Calculate accurately and efficiently
MP7. Look for and make use of structure.	• Discern patterns and structures • Can step back for an overview and shift perspective • See complicated things as single objects or as being composed of several objects

Social and Emotional Learning Standards	
Self-Awareness	• Recognize one's personal traits, strengths, and limitations • Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	• Recognize the skills needed to establish and achieve personal and educational goals • Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	• Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	• Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA Standards
• **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.
• **W.RW.11–12.7**	Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes.
	Science Standards
• **HS-PS1-1**	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms
• **HS-ESS1-4**	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system

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Computer Science & Design Thinking

8.1 Computer Science

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

8.2 Design Thinking

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.5.EG.1: Explain and give examples of what is meant by the term "tax."
- 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.
- 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.

9.4 Life Literacies & Key Skills

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

Evidence of Student Learning

Formative Tasks:

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

Alternative Assessments:

- Teacher-Created Projects
- https://www.illustrativemathematics.org/
- https://www.khanacademy.org/
- https://www.engageny.org

Summative Assessments:

- Unit Tests
- Midterm Exam
- Final Exam

Benchmark Assessments:

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

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Knowledge & Skills

Enduring Understandings:

- Rational exponents extend the properties of integer exponents and allow radicals to be expressed and manipulated using exponent rules.
- Radical and rational expressions can be rewritten in equivalent forms, which supports simplification and deeper algebraic reasoning.
- Simplifying radicals, including algebraic radicals, relies on structural understanding of factors, perfect powers, and properties of exponents.
- Solving rational and radical equations sometimes introduces extraneous solutions, requiring verification through substitution.
- The real number system can be extended to include complex numbers, enabling solutions to equations that have no real roots.
  Complex numbers behave according to established algebraic rules, allowing addition, subtraction, multiplication, and representation in standard form.
- Quadratic equations may have real or nonreal roots, and complex solutions emerge naturally from the structure of the equation.
- Algebraic structure and mathematical conventions allow expressions, equations, and number systems to be generalized and applied across multiple contexts.

Essential Questions:

- Why do we extend exponent rules to rational exponents, and how does this help us work with radicals more effectively?
- How can rewriting a radical or rational expression lead to a more efficient or insightful solution path?
- What strategies help determine the simplest form of a radical or algebraic radical expression?
- Why do extraneous solutions occur when solving rational and radical equations, and how can we detect them?
  What limitations exist in the real number system, and how does the introduction of complex numbers address them?
- How do the algebraic properties of operations extend to complex numbers in a consistent way?
- How can analyzing the structure of a quadratic equation help predict whether its solutions will be real or complex?
- How does understanding algebraic structure support problem solving across different types of expressions and equations?

Content

Students will know…

- The structure of radical expressions and how properties of exponents govern simplification.
- How radicals behave under multiplication, division, addition, and subtraction, including when terms are considered "like."
- That i represents $\sqrt{-1}$ and that powers of i follow a repeating cycle.
- The definition and structure of complex numbers in a + bi form.
- How real and imaginary parts interact during addition, subtraction, multiplication, and division.
- Complex conjugates are used to simplify division and rationalize denominators involving complex numbers.

Skills

Students will be able to …

- Simplify radicals containing numerical and variable terms using exponent properties.
- Add, subtract, multiply, and divide radical expressions and rationalize denominators when necessary.
- Rewrite expressions involving $\sqrt{-a}$ in terms of i and simplify powers of i efficiently.
- Represent complex numbers in a + bi form and perform all four arithmetic operations with them.
- Multiply and divide complex numbers using conjugates and express all results in a + bi form.
- Identify when expressions require simplification or rationalization to meet algebraic conventions.

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• The difference between real and imaginary solutions and how complex numbers extend the real number system.	• Connect symbolic manipulation with underlying structure, recognizing opportunities to use factoring, exponent rules, or conjugate pairs.

Core Instructional & Supplemental Materials

Suggested Activities/Resources:

- HS-RN Activities
- HS-CN Activities
- HS-A.REI Activities

Supplemental resources:

- https://www.illustrativemathematics.org/
- https://www.khanacademy.org/
- www.desmos.com
- www.kahoot.com
- www.quizizz.com
- https://www.deltamath.com
- https://www.ixl.com/math
- https://nj.digitalitemlibrary.com/home
- Mathematicians
- https://www.radicalmath.org/math-social-justice
- Alan Turing Gizmos Grades 9-12
- African Americans in Math

Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

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Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

504 Plans:

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Gifted and Talented:

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments
- Word Problems

- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project
- Interest Based/Choice Activities

Students at Risk of Failure:

- Extended Time
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Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
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- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

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Unit 2: Solve & Graph Quadratic Equations Solve absolute value equations Solve linear systems	21 days
New Jersey Learning Standards-Mathematics	
A.REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
A.REI.B.4.b	Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.
A.REI.C.5 (+)	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
A.REI.C.6	Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.
A.REI.C.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.
A.REI.D.11	Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
A.SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
F.BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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

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F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
G.GPE.A.2 (+)	Derive the equation of a parabola given a focus and directrix.

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	Science Standards
• **HS-PS1-4**	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
• **HS-ESS2-2**	Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.

Computer Science & Design Thinking

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Summative Assessments:

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- Final Exam

Benchmark Assessments:

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- Beginning/End of Year Assessment
- Unit Common Assessment

Knowledge & Skills

Enduring Understandings:

- Mathematical expressions and equations can be rewritten in multiple equivalent forms, and choosing the right form reveals important structural or contextual information about quantities, relationships, or solutions.
- Solving equations requires a logical sequence of justified steps, and understanding the reasoning behind each step strengthens students' ability to construct and critique mathematical arguments.

Essential Questions:

- How does rewriting an expression in a different but equivalent form help reveal characteristics or behaviors that are not immediately apparent?
- What makes a solution method valid, and how can we justify each algebraic step when solving equations?
- Why are multiple methods used to solve quadratic equations, and how do we determine which method is most efficient in a given situation?

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● Quadratic, linear, and nonlinear systems often represent real phenomena, and their solutions correspond to meaningful intersections or interactions between quantities. ● Different methods for solving equations, factoring, completing the square, elimination, graphing, or using the quadratic formula, provide different insights, and selecting the most efficient method depends on the structure of the expression or system. ● Graphs communicate essential features of relationships, such as intercepts, intervals of increase or decrease, symmetry, and points of intersection, which support mathematical modeling and interpretation of real situations. ● Transformations of functions follow predictable rules, and understanding these rules allows students to model changes, compare behaviors, and interpret how parameters affect the underlying relationship. ● Complex solutions naturally arise when extending the real number system, and these solutions enrich our ability to solve equations and represent mathematical phenomena beyond the real-number context. ● Geometric definitions, such as a focus and directrix, offer alternative ways to derive algebraic representations of curves, demonstrating the deep connections between geometry and algebra.	● What does the solution to a system of equations represent, and how do algebraic and graphical approaches provide different perspectives on the same problem? ● How do key features of graphs—intercepts, turning points, asymptotes, intervals, and intersections—help us understand the relationships between quantities? ● How do function transformations such as shifts, reflections, and dilations help us model real-world situations or compare mathematical behaviors? ● Why do some equations require complex solutions, and how does extending the number system to include complex numbers enhance our problem-solving capacity? ● How can geometric definitions, such as those involving focus and directrix, be used to derive algebraic equations and to deepen our understanding of conic sections like parabolas?
Content *Students will know…* ● How different forms of quadratic equations (standard, factored, vertex) reveal key features of the graph. ● The relationship between completing the square, the quadratic formula, and the vertex form of a quadratic. ● That quadratic equations can have two, one, or no real solutions, and that complex solutions arise when the discriminant is negative. ● How absolute value equations behave and why they can produce zero, one, or two solutions. ● How linear and quadratic equations intersect and what those intersection points represent on a graph. ● The structure of systems of equations and how	**Skills** *Students will be able to …* ● Solve quadratic equations using square roots, factoring, completing the square, and the quadratic formula. ● Convert quadratic equations from standard form to vertex form using completing the square. ● Graph quadratic and absolute value functions, identifying vertex, intercepts, axis of symmetry, and direction of opening. ● Analyze a quadratic in standard or vertex form to determine key characteristics of its graph. ● Solve absolute value equations and explain why the number of solutions varies across problems. ● Solve systems of two and three linear equations using substitution, elimination, and matrix-style

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solution types correspond to intersections of graphs. ● The roles of symmetry, vertex, and direction of opening in determining the shape and position of a parabola.	organization. ● Solve linear–quadratic systems algebraically and graphically, interpreting solutions as intersection points. ● Select appropriate solving methods based on structure, efficiency, and the form of the equation.

Core Instructional & Supplemental Materials

Suggested Activities/Resources:

- HS-A.REI Activities
- HS-A.SSE Activities
- HS-F.BF Activities
- HS-F.IF Activities

Supplemental resources:

- https://www.illustrativemathematics.org/
- https://www.khanacademy.org/
- www.desmos.com
- www.kahoot.com
- www.quizizz.com
- https://www.deltamath.com
- https://www.ixl.com/math
- https://nj.digitalitemlibrary.com/home
- https://www.radicalmath.org/math-social-justice
- Alan Turing Gizmos Grades 9-12
- African Americans in Math

Suggested Accommodations

English Language Learners:

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- Flexible Grouping
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Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
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Unit 3: Polynomials	18 days
New Jersey Learning Standards-Mathematics	
A.APR.A.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
A.APR.D.6	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.
A.APR.B.2	Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $x - a$ is a factor of $p(x)$.
A.APR.B.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
A.SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression
A.REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Standards of Mathematical Practices	
MP1. Make sense of problems and persevere in solving them	• Find meaning in problems • Look for entry points • Analyze, conjecture and plan solution pathways • Monitor and adjust • Verify answers • Ask themselves the question: “Does this make sense?”
MP2. Reason abstractly and quantitatively.	• Make sense of quantities and their relationships in problems • Learn to contextualized and decontextualized • Create coherent representations of problems
MP3. Construct viable arguments and critique the reasoning of others.	• Understand and use information to construct arguments

Grade: High School	Content Area: Mathematics - Algebra II

	• Make and explore the truth of conjectures • Recognize and use counterexamples • Justify conclusions and respond to arguments of others
MP4. Model with Mathematics.	• Apply mathematics to problems in everyday life • Make assumptions and approximations • Identify quantities in a practical situation • Interpret results in the context of the situation and reflect on whether the results make sense
MP5. Use appropriate tools strategically	• Consider the available tools when solving problems • Are familiar with tools appropriate for their grade or course (pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer programs, digital content located on a website, and other technological tools) • Make sound decisions of which of these tools might be helpful
MP6. Attend to precision.	• Communicate precisely to others • Use clear definitions, state the meaning of symbols and are careful about specifying units of measure and labeling axes • Calculate accurately and efficiently
MP7. Look for and make use of structure.	• Discern patterns and structures • Can step back for an overview and shift perspective • See complicated things as single objects or as being composed of several objects

Social and Emotional Learning Standards	
Self-Awareness	• Recognize one's personal traits, strengths, and limitations • Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	• Recognize the skills needed to establish and achieve personal and educational goals • Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	• Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	• Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA Standards
• **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.
• **W.RW.11–12.7**	Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes.

Grade: High School	Content Area: Mathematics - Algebra II

	Science Standards
• **HS-PS1-7**	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction
• **HS-LS2-1**	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

8.2 Design Thinking

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.5.EG.1: Explain and give examples of what is meant by the term “tax.”
- 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.
- 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.

9.4 Life Literacies & Key Skills

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

Evidence of Student Learning

Formative Tasks:

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

Alternative Assessments:

- Teacher-Created Projects
- https://www.illustrativemathematics.org/
- https://www.khanacademy.org/
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Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Mathematics - Algebra II

Summative Assessments:	Benchmark Assessments:
● Unit Tests ● Midterm Exam ● Final Exam	● Quarterly Benchmarks ● Beginning/End of Year Assessment ● Unit Common Assessment

Knowledge & Skills

Enduring Understandings:

- Polynomials form a complete algebraic system: Just as integers are closed under addition, subtraction, and multiplication, polynomials also form a closed system under these operations, which allows us to build and manipulate increasingly complex functions.
- Multiple representations are equivalent but not equally useful: A single polynomial can be expressed in standard form, factored form, or quotient–remainder form, and each representation highlights different features useful for problem solving and modeling.
- Division connects evaluation, factors, and zeros: Polynomial long division and the Remainder Theorem show a deep connection between evaluating a polynomial at a point, the remainder of division, and whether a binomial is a factor.
- Zeros, factors, and graphs are linked: The zeros of a polynomial correspond to its x-intercepts, and the multiplicity and location of these zeros shape the overall graph of the function.
- Rewriting expressions supports reasoning: Choosing and producing equivalent forms of expressions is a strategic tool for simplifying problems, uncovering hidden structure, and making solutions more transparent.
- Valid solutions require justified steps: Solving polynomial equations is not just about getting an answer; each algebraic step must follow logically from the last, and a solution method must be supported by a clear mathematical argument.

Essential Questions:

- In what ways do polynomials behave like integers, and why does closure under addition, subtraction, and multiplication matter for solving real problems?
- How does the form of a polynomial or rational expression influence what you can easily see or do with it (for example, factoring, graphing, or solving an equation)?
- When is it more useful to rewrite a polynomial in factored form, standard form, or quotient–remainder form, and how do you decide which form to use?
- What does the Remainder Theorem really tell us about evaluating a polynomial at a number, and how can this insight simplify checking for factors or zeros?
- How do the zeros and multiplicities of a polynomial function help you predict and sketch the overall shape and behavior of its graph?
- How can recognizing patterns and structure in expressions turn a complicated algebraic problem into a simpler one?
- What does it mean for a solution method to be “valid,” and how can you justify each algebraic step so that others are convinced your reasoning is sound?
- How can rewriting and analyzing polynomial expressions help you build and critique mathematical models of real-world situations?

Content *Students will know…*	**Skills** *Students will be able to …*

Grade: High School	Content Area: Mathematics - Algebra II

• The structure of polynomial expressions, including degree, leading coefficient, and how these features influence end behavior. • How polynomial operations (addition, subtraction, multiplication, division) follow the same algebraic rules as integer arithmetic. • How factoring reveals the roots of a polynomial and why polynomial equations may have real or complex solutions. • Complex roots occur in conjugate pairs when a polynomial has real coefficients. • How graphs of polynomial functions reflect their zeros, multiplicities, turning points, and long-run behavior. • The connection between polynomial division, factors, zeros, and the Remainder Theorem. • How the structure of a polynomial expression can be used to identify efficient strategies for rewriting or solving it.	• Add, subtract, multiply, and divide polynomials using methods such as long division or synthetic division. • Factor higher-degree polynomials using strategies such as GCF, grouping, special patterns, and quadratic-type factoring. • Solve polynomial equations by factoring and determine all real and complex roots. • Graph polynomial functions and identify key features including intercepts, end behavior, turning points, and multiplicities. • Apply the Polynomial Remainder Theorem to evaluate f(a) and determine whether a given value is a root. • Use the Factor Theorem and polynomial division to rewrite expressions and analyze function behavior. • Recognize when to apply synthetic division vs. long division or factoring when exploring polynomial structure. • Interpret solutions algebraically and graphically, connecting algebraic roots to features of the polynomial graph.

Core Instructional & Supplemental Materials

Suggested Activities/Resources:	Supplemental resources:
• HS-A.APR Activities • HS-A.SSE Activities • HS-A.REI Activities	• https://www.illustrativemathematics.org/ • https://www.khanacademy.org/ • www.desmos.com • www.kahoot.com • www.quizizz.com • https://www.deltamath.com • https://www.ixl.com/math • https://nj.digitalitemlibrary.com/home • https://www.radicalmath.org/math-social-justice • Alan Turing Gizmos Grades 9-12 • African Americans in Math

Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information

- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

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Gifted and Talented:

- Cooperative Learning Groups
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- Tiered Assignments
- Word Problems
- NJSLA questions
- Model Curriculum Questions
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- Interest Based/Choice Activities

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- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters

Grade: High School	Content Area: Mathematics - Algebra II

- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

UNIT 4: FUNCTIONS Domain and Range, Evaluating Functions, Inverse functions, function transformations	33 days
New Jersey Learning Standards-Mathematics	
F.IF.A	Understand the concept of a function and use function notation.
F.IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
F.IF.C.7e	Graph exponential and logarithmic functions, showing intercepts and end behavior.
F.BF.A.1	Write a function that describes a relationship between two quantities.
F.BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
F.BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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.
F.BF.B.4.a	Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse

Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Mathematics - Algebra II

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Grade: High School	Content Area: Mathematics - Algebra II

Social and Emotional Learning Standards	
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	Science Standards
• **HS-ESS3-1**	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
• **HS-ETS1-4**	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

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Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Mathematics - Algebra II

Career Readiness, Life Literacies & Key Skills

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Summative Assessments:

- Unit Tests
- Midterm Exam
- Final Exam

Benchmark Assessments:

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

Knowledge & Skills

Enduring Understandings:

- Functions provide a formal way to describe how quantities relate, and function notation allows us to represent, evaluate, and communicate those relationships precisely.
- Sequences are specialized functions whose domain is a subset of the integers, and both recursive and explicit representations can model real-world patterns.

Essential Questions:

- What makes a relation a function, and why does function notation matter when representing real-world situations?
- How do recursive and explicit forms of sequences differ, and how can each reveal different aspects of a pattern?
- How do graphs, tables, equations, and verbal descriptions each help us interpret and understand the behavior of a function?

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• Graphs, tables, equations, and verbal descriptions are interconnected representations of the same underlying function, each useful for revealing different features. • Key features of functions, such as intercepts, end behavior, asymptotes, maxima, minima, and rate of change, provide insight into the behavior of real-world phenomena. • Exponential and logarithmic functions model growth and decay, and their graphs reveal predictable patterns that support interpretation and prediction. • Transformations of functions follow consistent mathematical rules, allowing us to shift, stretch, compress, and reflect graphs while maintaining their fundamental shape. • Many functions have inverses that reverse input–output relationships, and understanding these relationships deepens comprehension of symmetry, solving equations, and modeling. • Building functions that describe relationships between quantities is central to mathematical modeling, enabling students to represent patterns, compare scenarios, and make decisions.	• Which key features of a graph or table are most important for understanding the relationship between variables? • How do exponential and logarithmic functions model real-world growth and decay, and what can their graphs tell us? • How do transformations such as f(x)+k, kf(x), f(kx), and f(x+k) change the appearance and meaning of a graph? • Why do some functions have inverses and others do not, and how does restricting the domain change this? • How can we construct a function that accurately describes the relationship between two quantities, and how do we evaluate whether it is a good model?
Content *Students will know…* • That a function represents a unique relationship between inputs and outputs, where each input has exactly one output. • How to represent functions using equations, graphs, and tables, and interpret function notation correctly. • How to determine the domain and range of a function both graphically and algebraically. • How transformations—translations, reflections, stretches, and compressions—affect the graph of a function. • The defining characteristics of even, odd, and neither functions based on symmetry. • How to recognize and describe the effects of constants in expressions such as f(x) + k, f(x + k), k·f(x), and f(kx). • That inverse functions “undo” each other and reflect across the line y = x. • How the parent radical, absolute value, linear, and	**Skills** *Students will be able to …* • Determine whether a relation is a function using tables, graphs, or ordered pairs. • Use function notation to evaluate and interpret real-world and mathematical situations. • Identify domain and range from equations, graphs, and verbal descriptions. • Perform operations with functions and simplify resulting expressions. • Graph parent and transformed functions, describing vertical/horizontal shifts, reflections, and dilations. • Classify functions as even, odd, or neither using graphical and algebraic reasoning. • Find the inverse of a function and verify the inverse relationship through composition and reflection over y = x. • Generalize transformation rules and apply them across multiple function families.

Grade: High School	Content Area: Mathematics - Algebra II

quadratic functions serve as foundational models for more complex functions.	

Core Instructional & Supplemental Materials	
Suggested Activities/Resources: • HS-F.BF Activities • HS-F.IF Activities	**Supplemental resources:** • https://www.illustrativemathematics.org/ • https://www.khanacademy.org/ • www.desmos.com • www.kahoot.com • www.quizizz.com • https://www.deltamath.com • https://www.ixl.com/math • https://nj.digitalitemlibrary.com/home • https://www.radicalmath.org/math-social-justice • Alan Turing Gizmos Grades 9-12 • African Americans in Math

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- Provide additional time

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- Credit Recovery
- Allow use of a calculator, when appropriate

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- Extra Practice
- Directions repeated, clarified, and reworded
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- Supplemental books
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Grade: High School	Content Area: Mathematics - Algebra II

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Grade: High School	Content Area: Mathematics - Algebra II

UNIT 5: Radical and Rational Equations and Functions	23 days
New Jersey Learning Standards-Mathematics	
A.REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
A.REI.A.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
A.REI.D.11	Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
A.APR.A.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
A.APR.D.6	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.
A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
F.IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers
F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

Standards of Mathematical Practices

Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Mathematics - Algebra II

MP1. Make sense of problems and persevere in solving them	● Find meaning in problems ● Look for entry points ● Analyze, conjecture and plan solution pathways ● Monitor and adjust ● Verify answers ● Ask themselves the question: “Does this make sense?”
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Grade: High School	Content Area: Mathematics - Algebra II

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	Science Standards
• **HS-PS2-3**	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
• **HS-ETS1-2**	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

8.2 Design Thinking

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
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- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.5.EG.1: Explain and give examples of what is meant by the term "tax."
- 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.
- 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.

Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Mathematics - Algebra II

9.4 Life Literacies & Key Skills

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

Evidence of Student Learning

Formative Tasks:

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

Alternative Assessments:

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Summative Assessments:

- Unit Tests
- Midterm Exam
- Final Exam

Benchmark Assessments:

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

Knowledge & Skills

Enduring Understandings:

- Equations represent relationships between quantities, and solving them requires logically justified steps that preserve equality.
- Rational, radical, and polynomial expressions follow structural rules that allow them to be rewritten in ways that reveal important mathematical properties.
- Graphs of functions provide visual insight into intersections, solutions, and the behavior of relationships across different domains.
- Polynomials behave as a closed system under addition, subtraction, and multiplication, making them predictable and structurally similar to integers.
- Dividing polynomials using long division or alternative methods reveals equivalent forms that

Essential Questions:

- How do we justify each algebraic step when solving an equation, and why must every step preserve equality?
- In what ways can rewriting a rational, radical, or polynomial expression make its properties or behavior easier to understand?
- What can the intersection points of two graphs tell us about the solutions to an equation?
- Why do polynomials form a system similar to the integers, and how does this structure help us perform algebraic operations?
- How does rewriting a rational expression using division provide insight into its behavior or graphical features?
- How can sequences be used as functions to model patterns or real-world changes?
- What strategies help us identify key features of a graph, and how do those features connect to symbolic or numerical representations?

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support deeper analysis, including identifying asymptotic behavior or simplified expressions. ● Function models, including sequences, describe how quantities change over time and allow for predictions in real contexts. ● The structure of expressions can be leveraged to simplify complex algebraic relationships and expose important functional characteristics. ● Solutions to equations often depend on understanding how graphs, tables, and symbolic expressions connect and represent the same underlying relationship.	● When solving equations that include rational, radical, or transcendental functions, how do different representations (graphs, tables, formulas) support accuracy and interpretation?
Content *Students will know…* ● That solving radical and rational equations may introduce extraneous solutions that must be verified. ● How the properties of exponents and radicals govern simplification and equivalence of algebraic expressions. ● That rational expressions can be simplified, added, subtracted, multiplied, or divided using the same principles as numeric fractions. ● How restrictions on the domain arise from denominators equaling zero or radicands being negative. ● The characteristics of the parent rational function f(x) = 1/x, including its asymptotes and general shape. ● How vertical and horizontal asymptotes describe long-term or boundary behavior of rational functions. ● That transformations such as shifts, reflections, and dilations modify the position and orientation of the parent rational graph. ● How the structure of a rational or radical equation determines the best method of solution.	**Skills** *Students will be able to …* ● Solve radical equations accurately and identify any extraneous roots through substitution. ● Simplify, multiply, divide, add, and subtract rational expressions using factoring and the concept of the "Big 1." ● Simplify complex fractions by identifying common denominators or multiplying by a strategic form of 1. ● Solve rational equations and determine restrictions on variable values. ● Graph the parent function f(x) = 1/x and describe its key features including asymptotes and intercepts. ● Identify vertical and horizontal asymptotes algebraically and graphically for rational functions. ● Apply vertical, horizontal, and reflective transformations to rational functions and explain the results. ● Analyze how coefficients and constants affect dilation and translation in rational function graphs.

Core Instructional & Supplemental Materials	
Suggested Activities/Resources: ● HS-A.APR Activities ● HS-A.SSE Activities ● HS-A.REI Activities ● HS-F.IF Activities	**Supplemental resources:** ● https://www.illustrativemathematics.org/ ● https://www.khanacademy.org/ ● www.desmos.com ● www.kahoot.com ● www.quizizz.com ● https://www.deltamath.com ● https://www.ixl.com/math

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	• https://nj.digitalitemlibrary.com/home • https://www.radicalmath.org/math-social-justice • Alan Turing Gizmos Grades 9-12 • African Americans in Math

Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

Grade: High School	Content Area: Mathematics - Algebra II

504 Plans:

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- Enriched Assignments
- Tiered Assignments
- Word Problems
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- Model Curriculum Questions
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- Interest Based/Choice Activities

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- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks

Grade: High School	Content Area: Mathematics - Algebra II

- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

Economically Disadvantaged:

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

UNIT 6: Exponential & Logarithmic Functions	29 days
New Jersey Learning Standards-Mathematics	
N.RN.A.1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
N.RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
A.REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

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A.REI.A.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
F.IF.C.7e	Graph exponential and logarithmic functions, showing intercepts and end behavior.
F.BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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.
F.LE.A.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
F.LE.A.4	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.

Standards of Mathematical Practices	
MP1. Make sense of problems and persevere in solving them	• Find meaning in problems • Look for entry points • Analyze, conjecture and plan solution pathways • Monitor and adjust • Verify answers • Ask themselves the question: “Does this make sense?”
MP2. Reason abstractly and quantitatively.	• Make sense of quantities and their relationships in problems • Learn to contextualized and decontextualized • Create coherent representations of problems
MP3. Construct viable arguments and critique the reasoning of others.	• Understand and use information to construct arguments • Make and explore the truth of conjectures • Recognize and use counterexamples • Justify conclusions and respond to arguments of others

Grade: High School	Content Area: Mathematics - Algebra II

MP4. Model with Mathematics.	• Apply mathematics to problems in everyday life • Make assumptions and approximations • Identify quantities in a practical situation • Interpret results in the context of the situation and reflect on whether the results make sense
MP5. Use appropriate tools strategically	• Consider the available tools when solving problems • Are familiar with tools appropriate for their grade or course (pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer programs, digital content located on a website, and other technological tools) • Make sound decisions of which of these tools might be helpful
MP6. Attend to precision.	• Communicate precisely to others • Use clear definitions, state the meaning of symbols and are careful about specifying units of measure and labeling axes • Calculate accurately and efficiently
MP7. Look for and make use of structure.	• Discern patterns and structures • Can step back for an overview and shift perspective • See complicated things as single objects or as being composed of several objects

Social and Emotional Learning Standards	
Self-Awareness	• Recognize one's personal traits, strengths, and limitations • Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	• Recognize the skills needed to establish and achieve personal and educational goals • Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	• Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	• Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA Standards
• **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.
• **W.RW.11–12.7**	Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes.
	Science Standards
• **HS-LS1-4**	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

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• **HS-PS1-5**	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

8.2 Design Thinking

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
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Evidence of Student Learning

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Grade: High School	Content Area: Mathematics - Algebra II

Summative Assessments:	Benchmark Assessments:
● Unit Tests ● Midterm Exam ● Final Exam	● Quarterly Benchmarks ● Beginning/End of Year Assessment ● Unit Common Assessment

Knowledge & Skills

Enduring Understandings:

- Rational exponents and radicals follow the same structural rules as integer exponents, allowing different forms of expressions to represent the same quantity.
- Exponential and logarithmic functions are inverses, and this relationship provides powerful tools for solving equations and modeling growth and decay.
- The structure of an algebraic expression can reveal important properties of the quantities it represents, especially when rewritten in an equivalent form.
- Solving rational and radical equations requires careful reasoning to ensure that solutions satisfy the original equation and do not introduce extraneous results.
- Graphs of exponential and logarithmic functions communicate intercepts, end behavior, and growth patterns that are not always evident in symbolic form.
- Transformations of functions, including shifts, stretches, compressions, and reflections, follow predictable rules that help students interpret and build models.
- Linear, exponential, and sequence-based models offer different ways to describe patterns of change, and choosing the appropriate model depends on the nature of the relationship.
- Understanding how to construct and analyze functions strengthens students' ability to describe real-world phenomena quantitatively and reason about long-term behavior.

Essential Questions:

- How do rational exponents extend the rules of integer exponents, and why is this extension useful?
- What can the structure of an expression reveal about the behavior of the quantity it represents?
- How can we determine whether a solution to a rational or radical equation is valid and not extraneous?
- What features of exponential and logarithmic graphs help us interpret real-world phenomena?
- How does transforming a function affect its graph and the relationship it models?
- In what situations is an exponential model more appropriate than a linear or recursive model?
- How does the inverse relationship between exponential and logarithmic functions support the process of solving equations?
- What information can be learned by comparing the graphs, tables, and symbolic forms of functions that represent the same relationship?

Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Mathematics - Algebra II

Content	Skills
Students will know… ● The properties of exponents and how they extend to rational exponents and radicals. ● The characteristics and graphs of exponential and logarithmic functions, including asymptotic behavior and domain/range. ● The inverse relationship between exponential and logarithmic functions. ● How transformations (translations, reflections, and dilations) affect exponential and logarithmic graphs. ● That logarithms represent exponents and follow specific algebraic properties (product, quotient, and power rules). ● How exponential equations can be rewritten and solved using logarithms. ● How real-world situations such as population growth, radioactive decay, and compound interest model exponential change. ● The meaning of parameters in exponential and logarithmic equations and how they influence graphs and solutions.	*Students will be able to …* ● Simplify exponential expressions using properties of exponents, including rational exponents. ● Evaluate and graph exponential functions and identify transformations from the parent function $y = a^x$. ● Write exponential equations from graphs or tables and interpret the base and initial value. ● Graph logarithmic functions and describe their relationship to exponential functions as inverses. ● Evaluate logarithmic expressions and simplify them using log rules. ● Solve exponential and logarithmic equations algebraically using properties and the change-of-base formula. ● Apply exponential and logarithmic models to solve real-world growth, decay, and compound-interest problems. ● Interpret solutions in context and verify that results are reasonable given the problem's parameters.

Core Instructional & Supplemental Materials

Suggested Activities/Resources:	Supplemental resources:
● HS-A.SSE Activities ● HS-A.REI Activities ● HS-F.IF Activities ● HS-F.BF Activities ● HS-N.RN Activities ● HS-F.LE Activities	● https://www.illustrativemathematics.org/ ● https://www.khanacademy.org/ ● www.desmos.com ● www.kahoot.com ● www.quizizz.com ● https://www.deltamath.com ● https://www.ixl.com/math ● https://nj.digitalitemlibrary.com/home ● https://www.radicalmath.org/math-social-justice ● Alan Turing Gizmos Grades 9-12 ● African Americans in Math

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- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

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- Extra help opportunities provided
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- Cooperative learning groups
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- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
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- Highlight key words

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- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
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UNIT 7: Introduction to Trigonometry	25 days
New Jersey Learning Standards-Mathematics	
F.TF.A	Extend the domain of trigonometric functions using the unit circle
F.TF.A.1 (+)	Understand the radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
F.TF.A.2 (+)	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
F.TF.A.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosines, and tangent for $\pi-x$, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number.
F.TF.B.5 (+)	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. ★
F.TF.B.6	Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
F.TF.B.7	Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.
G.SRT.C.6	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

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G.SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
A.REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Standards of Mathematical Practices	
MP1. Make sense of problems and persevere in solving them	• Find meaning in problems • Look for entry points • Analyze, conjecture and plan solution pathways • Monitor and adjust • Verify answers • Ask themselves the question: "Does this make sense?"
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MP3. Construct viable arguments and critique the reasoning of others.	• Understand and use information to construct arguments • Make and explore the truth of conjectures • Recognize and use counterexamples • Justify conclusions and respond to arguments of others
MP4. Model with Mathematics.	• Apply mathematics to problems in everyday life • Make assumptions and approximations • Identify quantities in a practical situation • Interpret results in the context of the situation and reflect on whether the results make sense
MP5. Use appropriate tools strategically	• Consider the available tools when solving problems • Are familiar with tools appropriate for their grade or course (pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer programs, digital content located on a website, and other technological tools) • Make sound decisions of which of these tools might be helpful
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MP7. Look for and make use of structure.	• Discern patterns and structures • Can step back for an overview and shift perspective • See complicated things as single objects or as being composed of several objects

Social and Emotional Learning Standards	
Self-Awareness	• Recognize one's personal traits, strengths, and limitations • Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	• Recognize the skills needed to establish and achieve personal and educational goals • Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
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	Science Standards
• **HS-ESS2-4**	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate
• **HS-PS3-1**	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Computer Science & Design Thinking

8.1 Computer Science

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

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- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
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Knowledge & Skills

Enduring Understandings:

- Trigonometric functions extend beyond right triangles and can be defined for all real numbers using the unit circle and radian measure.
- Radian measure links angle size to arc length, providing a natural way to describe rotation and periodic motion.
- The values of sine, cosine, and tangent for any angle can be understood and generated using special right triangles and symmetry on the unit circle.

Essential Questions:

- How does defining angles in radians and using the unit circle deepen our understanding of trigonometric functions compared with degree-only approaches?
- In what ways do special right triangles (30–60–90 and 45–45–90) help us determine exact trigonometric values for many other angles?
- How does the unit circle allow us to extend sine, cosine, and tangent to all real numbers and reason about symmetry, signs, and periodicity?

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• Trigonometric functions are inherently periodic, and their amplitude, frequency, and midline allow us to model and interpret recurring phenomena in the real world. • Restricting the domain of a trigonometric function to an interval where it is one-to-one makes it possible to define and use inverse trigonometric functions meaningfully. • Inverse trigonometric functions allow us to move from measured ratios or function values back to angle measures, which is essential in solving geometric and applied problems. • Similarity and the Pythagorean Theorem guarantee that trigonometric ratios depend only on angle measures, not on the size of the triangle, which underpins all trigonometric definitions. • Solving trigonometric equations requires coherent algebraic reasoning, careful attention to function behavior and domain, and interpretation of solutions within a given context.	• Why are amplitude, frequency, and midline essential when using trigonometric functions to model periodic phenomena in real contexts? • What domains must we choose in order to define inverse trigonometric functions, and how do those choices affect the solutions we obtain? • How do inverse trigonometric functions help us move from data or ratios back to unknown angles in geometric and applied situations? • Why do similar right triangles always produce the same trigonometric ratios for a given acute angle, and how does this idea justify the standard definitions of trig functions? • When solving a trigonometric equation, how can we be sure our solution method is valid, captures all appropriate solutions, and makes sense in the context of the problem?
Content *Students will know…* • The definitions of sine, cosine, and tangent as ratios of sides in right triangles. • The properties and exact values associated with special right triangles (30°–60°–90° and 45°–45°–90°). • How the unit circle extends trigonometric ratios to all real numbers through reference angles and symmetry. • That trigonometric functions are periodic and that coterminal angles share the same trigonometric values. • The meaning of radian measure is the ratio of arc length to radius. • The relationships between degree and radian measure and how to convert between them. • The signs and values of trigonometric functions in each quadrant on the unit circle. • How trigonometric equations can have multiple solutions within one or more rotations.	**Skills** *Students will be able to …* • Use right-triangle trigonometry to find unknown sides and angles in geometric and applied contexts. • Determine the side lengths of special right triangles without a calculator. • Use the reference angle and unit circle to find exact trigonometric values for common angles in degrees and radians. • Identify and find coterminal angles and use them to determine trigonometric ratios. • Convert between degrees and radians and explain the relationship between the two systems of measure. • Graph and analyze trigonometric values on the unit circle for key angles in both degrees and radians. • Solve trigonometric equations in degree and radian form, identifying all possible solutions. • Apply trigonometric reasoning to model and solve real-world problems involving angles, rotation, and periodic behavior.

Lakewood School DIstrict Curriculum Guide

Grade: High School	Content Area: Mathematics - Algebra II

Core Instructional & Supplemental Materials

Suggested Activities/Resources:

- HS-F.TF Activities
- HS-A.REI Activities
- HS-G.SRT Activities

Supplemental resources:

- https://www.illustrativemathematics.org/
- https://www.khanacademy.org/
- www.desmos.com
- www.kahoot.com
- www.quizizz.com
- https://www.deltamath.com
- https://www.ixl.com/math
- https://nj.digitalitemlibrary.com/home
- https://www.radicalmath.org/math-social-justice
- Alan Turing Gizmos Grades 9-12
- African Americans in Math

Suggested Accommodations

English Language Learners:

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

Special Education/Students with Disabilities:

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded

- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

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- Tiered Assignments
- Word Problems
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- Assistive Technology
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- Highlight key words
- Sentence starters
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- Activate schema
- Build background knowledge

Culturally Diverse:

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
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UNIT 8: Graphing Trigonometric Functions	22 days
New Jersey Learning Standards-Mathematics	
F.TF.B.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
F.IF.C.7f (+)	Graph trigonometric functions, showing period, midline, and amplitude.
F.BF.B.3	Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.
F.LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.

Standards of Mathematical Practices	
MP1. Make sense of problems and persevere in solving them	• Find meaning in problems • Look for entry points • Analyze, conjecture and plan solution pathways • Monitor and adjust • Verify answers • Ask themselves the question: "Does this make sense?"
MP2. Reason abstractly and quantitatively.	• Make sense of quantities and their relationships in problems • Learn to contextualized and decontextualized • Create coherent representations of problems
MP3. Construct viable arguments and critique the reasoning of others.	• Understand and use information to construct arguments • Make and explore the truth of conjectures • Recognize and use counterexamples • Justify conclusions and respond to arguments of others
MP4. Model with Mathematics.	• Apply mathematics to problems in everyday life • Make assumptions and approximations • Identify quantities in a practical situation • Interpret results in the context of the situation and reflect on whether the results make sense
MP5. Use appropriate tools strategically	• Consider the available tools when solving problems

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	● Are familiar with tools appropriate for their grade or course (pencil and paper, concrete models, ruler, protractor, calculator, spreadsheet, computer programs, digital content located on a website, and other technological tools) ● Make sound decisions of which of these tools might be helpful
MP6. Attend to precision.	● Communicate precisely to others ● Use clear definitions, state the meaning of symbols and are careful about specifying units of measure and labeling axes ● Calculate accurately and efficiently
MP7. Look for and make use of structure.	● Discern patterns and structures ● Can step back for an overview and shift perspective ● See complicated things as single objects or as being composed of several objects

Social and Emotional Learning Standards	
Self-Awareness	● Recognize one's personal traits, strengths, and limitations ● Recognize the importance of self-confidence in handling daily tasks and challenges
Self-Management	● Recognize the skills needed to establish and achieve personal and educational goals ● Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals
Social Awareness	● Demonstrate an understanding of the need for mutual respect when viewpoints differ
Responsible Decision-Making	● Develop, implement and model effective problem solving and critical thinking skills

Interdisciplinary Connections	
	ELA Standards
● **L.SS.11–12.1**	Demonstrate command of the system and structure of the English language when writing or speaking.
● **W.RW.11–12.7**	Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes.
	Science Standards
● **HS-PS4-1**	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
● **HS-ESS1-5**	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

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Computer Science & Design Thinking

8.1 Computer Science

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

8.2 Design Thinking

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

Career Readiness, Life Literacies & Key Skills

9.1 Personal Financial Literacy

- 9.1.5.EG.1: Explain and give examples of what is meant by the term “tax.”
- 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.
- 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.

9.4 Life Literacies & Key Skills

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

Evidence of Student Learning

Formative Tasks:	Alternative Assessments:
• Oral Questioning • Student Conference • Self-Assessment • Hand Signals • Communicators • Graphic Organizers • Teacher Observation • DOL • Quiz Classwork • NJSLA Released questions • Problem of the Day	• Teacher-Created Projects • https://www.illustrativemathematics.org/ • https://www.khanacademy.org/ • https://www.engageny.org
Summative Assessments:	**Benchmark Assessments:**
• Unit Tests • Midterm Exam • Final Exam	• Quarterly Benchmarks • Beginning/End of Year Assessment • Unit Common Assessment

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Knowledge & Skills

Enduring Understandings:

- Trigonometric functions can model periodic patterns found in real situations, such as waves, cycles, and oscillations.
- Amplitude, frequency, midline, and phase shift determine the overall shape and behavior of a trigonometric graph.
- Transformations of functions create predictable changes in graphs that allow students to interpret and manipulate models.
- Graphing technology and symbolic rules support accurate interpretation of trigonometric relationships.
- A single trigonometric expression can represent multiple forms of periodic behavior depending on its parameters.
- Connections between algebraic expressions and graphical features support deeper understanding of how quantities vary.
- Identifying how parameters affect a graph (f(x)+k, kf(x), f(kx), f(x+k)) strengthens students' ability to build and adjust mathematical models.
- Interpreting parameters in real contexts helps students understand how mathematical models represent real-world situations.

Essential Questions:

- How do amplitude, frequency, midline, and phase shift influence the shape of a trigonometric graph?
- What features of a trigonometric function allow it to model periodic real-world situations accurately?
- How do algebraic changes in a function's equation affect its graph?
- Why do different trigonometric equations sometimes represent graphs with similar behavior?
- How can transformations help us compare or predict changes in periodic patterns?
- In what ways does technology support the analysis and graphing of trigonometric functions?
- How can we determine the meaning of parameters in a trigonometric or exponential model when given a context?
- How do symbolic expressions, tables, and graphs each reveal different aspects of a function's behavior?

Content

Students will know…

- The key characteristics of sine, cosine, and tangent functions, including amplitude, period, midline, and phase shift.
- That sine and cosine are periodic functions defined by their values on the unit circle.
- How transformations affect trigonometric functions: vertical/horizontal shifts, reflections, and dilations.
- That the value of sine corresponds to the y-coordinate on the unit circle and cosine corresponds to the x-coordinate.
- The relationship between the parent graphs of sin(x), cos(x), and tan(x) and their transformed versions.
- How tangent's periodicity and asymptotes differ fundamentally from sine and cosine.
- How the parameters a, b, c, and k in $y = a \cdot \sin(bx +$

Skills

Students will be able to …

- Construct the graph of sin(x) using key points at 0, $\pi/2$, π, $3\pi/2$, and 2π.
- Graph sine, cosine, and tangent functions and identify amplitude, period, midline, phase shift, and asymptotes.
- Apply transformations to create graphs of $y = a \cdot \sin(bx + c) + k$, $y = a \cdot \cos(bx + c) + k$, and $y = a \cdot \tan(bx)$.
- Create equations for sine or cosine graphs by identifying amplitude, period, horizontal shift, and vertical shift.
- Distinguish between positive and negative transformations and describe the resulting reflections.
- Interpret trig graphs in terms of the unit circle, identifying corresponding angle measures.
- Analyze graphs in radians and degrees and switch between the two when needed.

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c) + k or y = a·cos(bx + c) + k shape the graph. ● How to match algebraic trigonometric equations to their graphical representations.	● Use trigonometric graphs to model periodic phenomena and verify solutions visually.

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Suggested Activities/Resources: ● HS-F.TF Activities ● HS-F.IF Activities ● HS-F.BF Activities ● HS-F.LE Activities	**Supplemental resources:** ● https://www.illustrativemathematics.org/ ● https://www.khanacademy.org/ ● www.desmos.com ● www.kahoot.com ● www.quizizz.com ● https://www.deltamath.com ● https://www.ixl.com/math ● https://nj.digitalitemlibrary.com/home ● https://www.radicalmath.org/math-social-justice ● Alan Turing Gizmos Grades 9-12 ● African Americans in Math

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