Shepard Preparatory High School

Pre-Calculus

Curriculum

Pre-Calculus completes the formal study of elementary functions begun in Algebra 1 and Algebra 2. Course topics include algebra, trigonometry, and analytic geometry. Students focus on the use of technology, modeling, and problem solving involving data analysis, trigonometric and circular functions, their inverses, polar coordinates, complex numbers, conics, and quadratic relations. Practice with proofs, such as mathematical induction, is included and experience with graphing calculators is incorporated.

Pre-Calculus

Unit 1	
Functions from a Calculus Perspective	
Timeframe	Week 1-6
Unit Overview	1. Identify functions from their equation or graph and analyze domain, range, and intercepts. 2. Determine continuity and behavior of a function. 3. Graphs of functions provide a visual representation between two variables.
Essential Questions	1. How do rigid and nonrigid transformations affect its graph? 2. How can operations be performed on two functions? 3. How are inverse functions related? 4. When would it be appropriate to use a linear function or quadratic function to model a real-life situation?
Unit Focus	• the characteristics, elements and forms of a linear function • the relationships between quantities • the graph of a function is the collection of ordered pairs (x,f(x)) • the relationship between symmetry and even/odd functions • the derivation of complicated graphs by rigid and nonrigid transformations • arithmetic combinations and compositions of functions • the relationship between inverse functions and their graphs • to create scatter plots and model data using a graphing utility
Interdisciplinary Connections	• NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests

Materials

Common Materials	Supplemental Materials
Glencoe PreCalculus by McGraw Hill Kuta Software Worksheets Khan Academy	Teacher created materials

New Jersey Student Learning Standards (NJSLS)			
Subject Area **Mathematics**	**Technology** *8.1: Educational Technology* *8.2: Technology Education, Engineering, Design and Computational Thinking - Programming*	**21st Century Life and Careers** NJSLS-9.4 Life Literacies and Key Skills	**ELA Companion** *Secondary Science and Social Studies Only* N/A
Functions F.BF.A. Building Functions Build a function that models a relationship between two quantities. ★ F.BF.A.1.a Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. F.BF.B. Building Functions Build new functions from existing functions 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. Include recognizing even and odd functions from their graphs and algebraic expressions for them. F.BF.B.4.a Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse.	NJ: 2020 SLS: Science NJ: Grades 9-12 HS-ETS1 Engineering Design Students who demonstrate understanding can: 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. 9.3 – Career & Technical Education (CTE): Science, Technology, Engineering & Mathematics Career Cluster ® Career Cluster®: Science, Technology, Engineering & Mathematics (st) 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. Science & Mathematics Career Pathway (ST-SM) 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). • 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening

F.IF.A. Interpreting Functions Understand the concept of a function and use function notation F.IF.A.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). F.IF.A.2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F.IF.B. Interpreting Functions Interpret functions that arise in applications in terms of the context F.IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ★ F.IF.C. Interpreting Functions Analyze functions using different representations F.IF.C.7.a Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ a. Graph linear and quadratic functions and show intercepts, maxima, and minima. F.LE.A. Linear, Quadratic and Exponential Models Construct and compare linear and exponential models and solve problems F.LE.A.1.a Distinguish between situations that can be modeled with linear functions and with exponential functions.	and projects that address real world problems.		

Pre-Calculus

a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. ★ F.IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ★ F.IF.C. Interpreting Functions Analyze functions using different representations F.IF.C.7.a Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ a. Graph linear and quadratic functions and show intercepts, maxima, and minima. F.IF.C.8.a Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.			
Differentiation			
Differentiation for Support and General Curriculum (504, ELL, Special Education, Struggling Learners)	**Differentiation for Enrichment**		

Pre-Calculus

Modifications for Classroom: Pair visual prompts with verbal presentations Ask students to restate information, directions, and assignments Model skills / techniques to be mastered Extended time to complete class work Student-directed learning/ independent studies when appropriate **Modifications for Homework and Assignments**: Extended time to complete assignments Provide the student with clearly stated (written) expectations and grading criteria for assignments **Modifications for Assessments:** Extended time on classroom assessments	Use of higher level questioning techniques Provide assessments that require higher level thinking Increased production Substituting written texts with project-based learning Student-directed learning/ independent studies Extension activities **Further Modifications for Honors Students** Students in Honors courses, in addition to regular class assignments, will complete enrichment/extension activities outside of the regular class period. These assignments may be projects, labs, research papers, independent novel study, or other activities assigned by the teacher

Activities

Engaging mathematics learning activities include hands-on games, movement-based challenges, and creative projects that make abstract concepts tangible

Hands-on & Interactive Game Examples

- **Math War (Cards):** Students play with cards to practice multiplication or addition, trying to get the highest result.
- **Math Bingo:** A fun way for students to practice multiplication, division, or addition in a group setting.
- **Dice Rolling Games:** Roll dice to create and solve numbers, or use them to build shapes and towers.

Movement-Based Math

- **Math Scavenger Hunt:** Hide numbers or equations around the room or outside for children to find
- **Math Relay Races:** Students run to solve problems in teams, combining physical activity with mental calculation.
- **Human Number Line:** Use body movement to represent positions on a number line, Walking number lines to demonstrate concepts like adding and subtracting negative numbers.

Creative & Visual Projects

- **Nature Sorting:** Collecting leaves or sticks during a walk to practice sorting, sequencing, and measurement and probability.
- **Marshmallow Geometry:** Using marshmallows and toothpicks to build 3D shapes.

Digital & Cognitive Activities

- **Virtual Manipulatives:** Using online tools like geoboards or fraction bars.
- **Brain Teasers/Riddles:** Daily puzzles that encourage logical thinking and problem-solving skills.
- **Virtual Escape Rooms:** Engaging, technology-based puzzles for older students.

Pre-Calculus

Unit 2	
Rational Functions (Polynomial Review)	
Timeframe	Week 7-10
Unit Overview	1. Change does not always occur at a linear rate 2. Real life situations can be modeled using quadratic functions and functions of higher degree in order to optimize and predict behaviors
Essential Questions	1. How do the characteristics of a polynomial function affect its graph? 2. When would it be appropriate to use a quadratic function to model a real-life situation versus a polynomial of higher degree? 3. When would it be appropriate to use a rational function to model a real-life situation?
Unit Focus	• the characteristics of a quadratic function • the graph of a quadratic function is a parabola with a vertex, axis of symmetry, extrema and direction • the leading coefficient test will determine the end behaviors of polynomial functions • polynomial functions may have real and nonreal roots • Descartes rule of signs, the Rational Root test, upper and lower bound test and long and synthetic division • operations on complex numbers • horizontal and vertical asymptotes behaviors of rational functions • rational inequalities • partial fraction decomposition
Interdisciplinary Connections	• NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests
Materials	
Common Materials	**Supplemental Materials**

Glencoe PreCalculus by McGraw Hill Kuta Software Worksheets Khan Academy	Teacher created materials

New Jersey Student Learning Standards (NJSLS)			
Subject Area **Mathematics**	**Technology**	**21st Century Life and Careers**	**ELA Companion**
Algebra A.APR.B. Arithmetic with Polynomials and Rational Expressions Understand the relationship between zeros and factors of polynomials 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.APR.D. Rewrite rational expressions A.APR.D.6. Rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form $q(x) + \frac{r(x)}{b(x)}$, where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x) using inspection, long division, or, for the more complicated examples, a computer algebra system. A.APR.D.7. (+) 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. A.SSE.B. Seeing Structure in Expressions Write expressions in equivalent forms to solve problems	NJ: 2020 SLS: Science NJ: Grades 9-12 • HS-ETS1 Engineering Design • Students who demonstrate understanding can: 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.	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). • 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening

A.SSE.B.3.a Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★ a. Factor a quadratic expression to reveal the zeros of the function it defines. Functions F.IF.B. Interpreting Functions Interpret functions that arise in applications in terms of the context 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.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ★  F.IF.C. Interpreting Functions Analyze functions using different representations F.IF.C.7.a Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ a. Graph linear and quadratic functions and show intercepts, maxima, and minima.			

Differentiation	
Differentiation for Support and General Curriculum (504, ELL, Special Education, Struggling Learners)	**Differentiation for Enrichment**
Modifications for Classroom: Pair visual prompts with verbal presentations Ask students to restate information, directions, and assignments Model skills / techniques to be mastered Extended time to complete class work Student-directed learning/ independent studies when appropriate	Use of higher level questioning techniques Provide assessments that require higher level thinking Increased production Substituting written texts with project-based learning Student-directed learning/ independent studies Extension activities

Modifications for Homework and Assignments: Extended time to complete assignments Provide the student with clearly stated (written) expectations and grading criteria for assignments **Modifications for Assessments:** Extended time on classroom assessments	**Further Modifications for Honors Students** Students in Honors courses, in addition to regular class assignments, will complete enrichment/extension activities outside of the regular class period. These assignments may be projects, labs, research papers, independent novel study, or other activities assigned by the teacher

Activities

Engaging mathematics learning activities include hands-on games, movement-based challenges, and creative projects that make abstract concepts tangible

Hands-on & Interactive Game Examples

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- **Math Bingo:** A fun way for students to practice multiplication, division, or addition in a group setting.
- **Dice Rolling Games:** Roll dice to create and solve numbers, or use them to build shapes and towers.

Movement-Based Math

- **Math Scavenger Hunt:** Hide numbers or equations around the room or outside for children to find
- **Math Relay Races:** Students run to solve problems in teams, combining physical activity with mental calculation.
- **Human Number Line:** Use body movement to represent positions on a number line, Walking number lines to demonstrate concepts like adding and subtracting negative numbers.

Creative & Visual Projects

- **Nature Sorting:** Collecting leaves or sticks during a walk to practice sorting, sequencing, and measurement and probability.
- **Marshmallow Geometry:** Using marshmallows and toothpicks to build 3D shapes.

Digital & Cognitive Activities

- **Virtual Manipulatives:** Using online tools like geoboards or fraction bars.
- **Brain Teasers/Riddles:** Daily puzzles that encourage logical thinking and problem-solving skills.
- **Virtual Escape Rooms:** Engaging, technology-based puzzles for older students.

Unit 3

Pre-Calculus

Exponential and Logarithmic Functions	
Timeframe	Week 11-16
Unit Overview	1. Quantities can increase or decrease at either a rapid or slow rate. 2. Logarithms can be of base 10 (common), base e (natural), or other numeric bases. 3. Exponential and logarithmic functions can be used model and solve real-life applications.
Essential Questions	1. When would it be appropriate to use an exponential function to model a real-life situation? 2. When would it be appropriate to use a logarithmic function to model a real-life situation? 3. Which regression model (linear, quadratic, power, exponential, logarithmic, or logistic) is best for a specific set of data? 4. How does changing the base of a function impact the graph?
Unit Focus	• characteristics of exponential functions and their graphs • characteristics of logarithmic functions and their graphs • the difference between the common logarithm and the natural logarithm • the affects of changing the base on an exponential or logarithmic function • properties of logarithms to evaluate and rewrite logarithmic expressions • properties of logarithms to expand or condense logarithmic expressions • properties of logarithms to solve exponential and logarithmic equations. • exponential and logarithmic functions that can model real-life situations
Interdisciplinary Connections	• NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests

Materials	
Common Materials	**Supplemental Materials**
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New Jersey Student Learning Standards (NJSLS)			
Subject Area	**Technology**	**21st Century Life and Careers**	**ELA Companion**
F.BF.A. Building Functions Build a function that models a relationship between two quantities. ★ F.BF.A.1.a Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. F.BF.B. Building Functions Build new functions from existing functions 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. Include recognizing even and odd functions from their graphs and algebraic expressions for them. F.BF.B.4.a Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. F.IF.A. Interpreting Functions Understand the concept of a function and use function notation F.IF.A.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The	NJ: 2020 SLS: Science NJ: Grades 9-12 HS-ETS1 Engineering Design Students who demonstrate understanding can: 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. 9.3 – Career & Technical Education (CTE): Science, Technology, Engineering & Mathematics Career Cluster ® Career Cluster®: Science, Technology, Engineering & Mathematics (st) 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. Engineering & Technology Career Pathway (ST-ET) 9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems. Science & Mathematics Career Pathway (ST-SM) 9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems. 9.3.ST-SM.3 Analyze the impact that science	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). • 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening

graph of f is the graph of the equation y = f(x). F.IF.A.2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F.IF.B. Interpreting Functions Interpret functions that arise in applications in terms of the context 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.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ★ F.IF.C. Interpreting Functions Analyze functions using different representations F.IF.C.7.a Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ a. Graph linear and quadratic functions and show intercepts, maxima, and minima. F.LE.A. Linear, Qudratic and Exponential Models Construct and compare linear and exponential models and solve problems F.LE.A.1.c Distinguish between situations that can be modeled with linear functions and with exponential functions. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. F.LE.B. Linear, Quadratic and Exponential Models Interpret expressions for functions in terms of the situation they model F.LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context.	and mathematics has on society.		

Differentiation	
Differentiation for Support and General Curriculum (504, ELL, Special Education, Struggling Learners)	**Differentiation for Enrichment**
Modifications for Classroom: Pair visual prompts with verbal presentations Ask students to restate information, directions, and assignments Model skills / techniques to be mastered Extended time to complete class work Student-directed learning/ independent studies when appropriate **Modifications for Homework and Assignments**: Extended time to complete assignments Provide the student with clearly stated (written) expectations and grading criteria for assignments **Modifications for Assessments:** Extended time on classroom assessments	Use of higher level questioning techniques Provide assessments that require higher level thinking Increased production Substituting written texts with project-based learning Student-directed learning/ independent studies Extension activities **Further Modifications for Honors Students** Students in Honors courses, in addition to regular class assignments, will complete enrichment/extension activities outside of the regular class period. These assignments may be projects, labs, research papers, independent novel study, or other activities assigned by the teacher
Activities	
Engaging mathematics learning activities include hands-on games, movement-based challenges, and creative projects that make abstract concepts tangible **Hands-on & Interactive Game Examples** • **Math War (Cards):** Students play with cards to practice multiplication or addition, trying to get the highest result. • **Math Bingo:** A fun way for students to practice multiplication, division, or addition in a group setting. • **Dice Rolling Games:** Roll dice to create and solve numbers, or use them to build shapes and towers. **Movement-Based Math** • **Math Scavenger Hunt:** Hide numbers or equations around the room or outside for children to find • **Math Relay Races:** Students run to solve problems in teams, combining physical activity with mental calculation.	

• **Human Number Line:** Use body movement to represent positions on a number line, Walking number lines to demonstrate concepts like adding and subtracting negative numbers. **Creative & Visual Projects** • **Nature Sorting:** Collecting leaves or sticks during a walk to practice sorting, sequencing, and measurement and probability. • **Marshmallow Geometry:** Using marshmallows and toothpicks to build 3D shapes. **Digital & Cognitive Activities** • **Virtual Manipulatives:** Using online tools like geoboards or fraction bars. • **Brain Teasers/Riddles:** Daily puzzles that encourage logical thinking and problem-solving skills. • **Virtual Escape Rooms:** Engaging, technology-based puzzles for older students.	

Pre-Calculus

Unit 4	
Unit 4: Trigonometric Functions	
Timeframe	Week 17-26
Unit Overview	1. SOH, CAH, TOA - the acronym for creating the trigonometric ratios 2. Real life situations can be modeled by using right triangle trigonometry
Essential Questions	1. Is it possible to evaluate trigonometric functions of any angle? 2. How do the characteristics of a trigonometric function affect its graph? 3. When would it be appropriate to use a trigonometric function to model a real-life situation? 4. What is a radian?
Unit Focus	• angle descriptions • conversions between degree and radian measure • the unit circle and its relationship to real numbers • the definitions/ratios of the six trigonometric functions • the fundamental trigonometric identities • trigonometric functions of acute angles, special angles and quadrantal angles • reference angles and their relationship to evaluating trigonometric functions of non acute angles • the characteristics of the graphical representations of the six trigonometric functions (domain, range, period and amplitude) • translations of the six trigonometric functions • characteristics and graphical representations of inverse trigonometric functions • compositions of trigonometric functions • how to find missing sides and angles of oblique triangles • how to find area of oblique triangles
Interdisciplinary Connections	• NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests
Materials	
Common Materials	

	Supplemental Materials
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New Jersey Student Learning Standards (NJSLS)			
Subject Area	**Technology**	**21st Century Life and Careers**	**ELA Companion**
G.SRT.C. Similarity, Right Triangles, and Trigonometry Define trigonometric ratios and solve problems involving right triangles G.SRT.C.7. Explain and use the relationship between the sine and cosine of complementary angles. G.SRT.C.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★ G.SRT.D. Similarity, Right Triangles, and Trigonometry Apply trigonometry to general triangles G.SRT.D.9. (+) Derive the formula $A = \frac{1}{2}ab\sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. G.SRT.D.10. (+) Prove the Laws of Sines and Cosines and use them to solve problems. G.SRT.D.11. (+) Understand and apply	NJ: 2020 SLS: Science NJ: Grades 9-12 HS-ETS1 Engineering Design Students who demonstrate understanding can: 9.1 Personal Financial Literacy: Credit and Debt Management There are reasons and consequences to taking on debt. 9.1.12.CDM.1: Identify the purposes, advantages, and disadvantages of debt. 9.1.12.CDM.4: Identify issues associated with student loan debt, requirements for repayment, and consequences of failure to repay student loan debt. There are ways to evaluate loans and their impact on one's personal financial plan. 9.1.12.CDM.6: Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit. (e.g., student loans, credit cards, auto loans,	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). • 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening

the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces) Functions F.BF.A. Building Functions Build a function that models a relationship between two quantities. ★ F.BF.A.1.c Write a function that describes a relationship between two quantities. c. (+) Compose functions. F.BF.B. Building Functions Build new functions from existing functions 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. Include recognizing even and odd functions from their graphs and algebraic expressions for them. F.IF.A. Interpreting Functions Understand the concept of a function and use function notation F.IF.A.2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F.IF.B. Interpreting Functions Interpret functions that arise in applications in terms of the context 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	mortgages, etc.). 9.1 Personal Financial Literacy: Credit Profile Negative information in credit reports can affect a person's credit score and financial options. 9.1.12.CP.1: Summarize how one's credit history can affect finances, including loan terms, employment, and qualifying for loans. 9.1.12.CP.2: Identify the advantages of maintaining a positive credit history. Building and maintaining a good credit history is a process. 9.1.12.CP.3: Summarize factors that affect a positive credit rating, including on-time payments, debt versus available credit, length of open credit, and how often you apply for credit. 9.1.12.CP.4: Identify the skill sets needed to build and maintain a positive credit profile. 9.2 Career Awareness, Exploration, Preparation, and Training Career planning requires purposeful planning based on research, self-knowledge, and informed choices. 9.2.12.CAP.10: Identify strategies for reducing overall costs of postsecondary education (e.g., tuition assistance, loans, grants, scholarships, and student loans). NJ: 2020 SLS: Computer Science & Design Thinking NJ: End of Grade 12 8.1 Computer Science: Data & Analysis Individuals select digital tools and design automated processes to collect, transform, generalize, simplify, and present large data sets in different ways to influence how other people interpret and understand the		

sketch graphs showing key features given a verbal description of the relationship. ★ F.IF.C. Interpreting Functions Analyze functions using different representations F.IF.C.7.f Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ f. (+)Graph trigonometric functions, showing period, midline, and amplitude. F.TF.A. Trigonometric Functions Extend the domain of trigonometric functions using the unit circle F.TF.A.1. (+) Understand 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 $\frac{\pi}{3}, \frac{\pi}{4}$, and $\frac{\pi}{6}$ and use the unit circle to express the values of sine, cosines, and tangent for π-x, π+x and 2π-x in terms of their values for x, where x is any real number. F.TF.A.4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. F.TF.B. Trigonometric Functions Model periodic phenomena with trigonometric functions F.TF.B.5. (+) Choose trigonometric	underlying information. 8.1.12.DA.1: Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change		

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. ★			

Differentiation

Differentiation for Support and General Curriculum (504, ELL, Special Education, Struggling Learners)	Differentiation for Enrichment
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Unit 5	
Trigonometric Identities and Equations	
Timeframe	Week 27-31
Unit Overview	1. the fundamental trigonometric identities are used to evaluate trigonometric functions, simplify and rewrite expressions. 2. basic algebraic operations can be used to solve trigonometric equations

	3. trigonometric equations can be useful in modeling and solving real-life problems
Essential Questions	1. What is the difference between a trigonometric expression and a trigonometric equation? 2. Is it acceptable to use operations of equality when verifying a trigonometric identity? 3. Is one method of solving a trigonometric equation better than another? 4. How do you decide which method is best to solve a trigonometric equation? 5. Can methods of solving quadratic equations be used when solving trigonometric equations of quadratic type?
Unit Focus	• usages for the fundamental identities • verifications of trigonometric identities • methods to solve trigonometric equations • sum and difference formulas • multiple-angle and product-to-sum formulas
Interdisciplinary Connections	• NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests

Materials

Common Materials	Supplemental Materials
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	Engineering, Design and Computational Thinking - Programming	*9.2: Career Awareness, Exploration, and Preparation*	N/A
Standards for Mathematical Practice MP.1 Make sense of problems and persevere in solving them MP.4 Model with mathematics MP.6 Attend to precision Functions F.TF.A. Trigonometric Functions Extend the domain of trigonometric functions using the unit circle F.TF.A.3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\frac{\pi}{3}, \frac{\pi}{4}, \text{and} \frac{\pi}{6}$ and use the unit circle to express the values of sine, cosines, and tangent for π-x, π+x and 2π-x in terms of their values for x, where x is any real number. F.TF.B. Trigonometric Functions Model periodic phenomena with trigonometric functions 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. ★ F.TF.C. Trigonometric Functions Prove and apply trigonometric identities F.TF.C.8. (+) Prove the Pythagorean identity $\sin^2(\theta) + \cos^2\theta = 1$ and use it to find sin(θ), cos(θ) or tan(θ) given	NJ: 2020 SLS: Science NJ: Grades 9-12 • HS-ETS1 Engineering Design • Students who demonstrate understanding can: 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.	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). • 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening

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sin(θ), cos(θ) or tan(θ) and the quadrant of the angle. F.TF.C.9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.			

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Activities

Unit 6	
Systems of Equations and Matrices	
Timeframe	Weeks 31-34
Unit Overview	1. write matrices and identify their order 2. perform row operations on matrices 3. use matrices and Gaussian elimination to solve systems of equations 4. use matrices and Gauss-Jordan elimination to solve systems of equations
Essential Questions	1. How can data be organized and manipulated using matrices? 2. What makes matrix operations defined or undefined? 3. How can computers and calculators use matrices to solve complex systems of equations quickly? 4. How are matrices used to transform images in computer graphics?
Unit Focus	• methods of solving systems of equations such as substitution, elimination, Gaussian elimination and Gauss-Jordan elimination • methods of solving systems of equations by using inverse matrices • row-echelon and back-substitution to solve systems • nonsquare systems of equations • models and real-life problems that involve matrices and systems of equations • operations with matrices • inverse matrices • determinants of square matrices
Interdisciplinary Connections	• NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests

Materials	
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N.VM.C. Vector and Matrix Quantities Perform operations on matrices and use matrices in applications N.VM.C.7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. N.VM.C.8. (+) Add, subtract, and multiply matrices of appropriate dimensions. N.VM.C.9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. N.VM.C.10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.	NJ: 2020 SLS: Science NJ: Grades 9-12 HS-ETS1 Engineering Design Students who demonstrate understanding can: 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. . Career Cluster®: Science, Technology, Engineering & Mathematics (st) 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. 9.3.ST.6 Demonstrate technical skills needed in a chosen STEM field. Engineering & Technology Career Pathway (ST-ET) 9.3.ST-ET.4 Apply the elements of the design process. Science & Mathematics Career Pathway (ST-SM)	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). • 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening .

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	9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.		

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Unit 7	
Conic Sections	
Timeframe	Week 35-38
Unit Overview	1. Parabolas can be used in real-life applications such as projectile motion, road design, satellite dishes 2. Circles are a special case of the Ellipse 3. Eccentricity measures the elongation of the ellipse 4. Orbital patterns are elliptical in shape 5. Hyperbolas are used sonar applications 6. Conics are used in real-life problems
Essential Questions	1. How can we determine the classification of the conic by its general equation? 2. How can the standard form of the equation assist in graphing the conic section? 3. What is the relationship between the foci of the conic and the conic itself? 4. What is the relationship between a circle and an ellipse?

Unit Focus	• properties of the circle, parabola, ellipse, and hyperbola • graphical representations of the circle, parabolas, ellipses and hyperbolas • the general and standard forms for the equations of the conic sections • models to solve real-life problems
Interdisciplinary Connections	21st Century Life Skills and Careers • NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests

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G.GPE.A. Expressing Geometric Properties with Equations Translate between the geometric description and the equation for a conic section G.GPE.A.1. (+) Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the	NJ: 2020 SLS: Science NJ: Grades 9-12 HS-ETS1 Engineering Design Students who demonstrate understanding can:	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening

square to find the center and radius of a circle given by an equation. G.GPE.A.2. (+) Derive the equation of a parabola given a focus and directrix. G.GPE.A.3. (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.	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. Career Cluster®: Science, Technology, Engineering & Mathematics (st) 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data. Engineering & Technology Career Pathway (ST-ET) 9.3.ST-ET.4 Apply the elements of the design process. Science & Mathematics Career Pathway (ST-SM) 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.	• 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	
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Unit 8	
Polar Coordinates	
Timeframe	Week 39-40
Unit Overview	1. Not all situations can be modeled graphically on a rectangular coordinate plane 2. Polar graphs can be used to model situations involving sound, location, motion of specific objects etc. 3. There are many ways to graph relations and functions that we have already covered i.e. trigonometric functions and conics - depending on the situation one graph might be easier or more effective to use
Essential Questions	1. Why is it helpful to have more than one coordinate system? 2. What situations might be modeled best with a polar coordinate grid/graph?
Unit Focus	• Polar Coordinates and their graphs • Polar and rectangular forms of equations
Interdisciplinary Connections	• NJSLS-9.4 Life Literacies and Key Skills
Common Assessments	• Assessment Suite chapter quizzes and tests

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MP Mathematical Practice Standards for Mathematical Practice MP.4 Model with mathematics Number and Quantity N.CN.B. The Complex Number System Represent complex numbers and their operations on the complex plane N.CN.B.4. (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number. Functions F.TF.A. Trigonometric Functions Extend the domain of trigonometric functions using the unit circle F.TF.A.3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\frac{\pi}{3}, \frac{\pi}{4}, \text{and} \frac{\pi}{6}$ and use the unit circle to express the values of sine, cosines, and tangent for π-x, π+x and 2π-x in terms of their	NJ: 2020 SLS: Science NJ: Grades 9-12 • HS-ETS1 Engineering Design • Students who demonstrate understanding can: 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.	• 9.4.2.CI.1: Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). • 9.4.2.CI.2: Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). • 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive). 9.4.2.IML.1: Identify a simple search term to find information in a search engine or digital resource. 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).	NJ: 2023 SLS: English Language Arts NJ: Grades 11-12 • Speaking and Listening Domain • Speaking and Listening

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