Pre Calculus Honors

Unit Title: **Rational and Irrational Expressions; Polynomials**

Stage 1: Desired Results

Standards & Indicators:

Arithmetic with Polynomials and Rational Expressions A –APR

A. Perform arithmetic operations on polynomials

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

B. Understand the relationship between zeros and factors of polynomials

2. Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).

3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

C. Use polynomial identities to solve problems

4. Prove polynomial identities and use them to describe numerical relationships. For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity (x2 + y2) 2 = (x2 – y2) 2 + (2xy) 2 can be used to generate Pythagorean triples.

5. (+) Know and apply the Binomial Theorem for the expansion of (x + y) n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

D. Rewrite rational expressions

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.

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.

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g.1.1.12prof.CR3a).	With a growth mindset, failure is an important part of success.
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work	Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.

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	better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, .1.IL.IPERS.7, 8.2.12.ETW.3).	
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.

Central Idea/Enduring Understanding:	**Essential/Guiding Question:**
Rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression.	How can we rewrite rational expressions in different forms using inspection, long division, or computer algebra? How can we subtract, multiply, and divide rational expressions? How can we know and apply the Remainder Theorem? How can we identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by a polynomial How can we know and apply the Binomial Theorem for the expansion of (x+ y)n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle?
Content: Rational Expressions Zeros of Polynomials Remainder Theorem BinomialTheorem	**Skills(Objectives):** Simplify radical expressions and rational exponents and to rationalize the denominator. Reduce and perform operations with rational expressions. Determine the domain of rational expressions. Simplify compound rational expressions. Rewrite simple rational expressions in different forms using inspection, long division, or computer algebra system for more complicated examples. Add, subtract, multiply, and divide rational expressions Apply the Remainder Theorem 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. Perform synthetic division.

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	Find the real and complex zeros of a function. Understand and use the Fundamental Theorem of Algebra. Expand binomials. Know and apply the Binomial Theorem for the expansion of (x+ y)n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle

Interdisciplinary Connections:

Interdisciplinary connections are integrated in each unit with connections to the mathematical practices.

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Stage 2: Assessment Evidence

Performance Task(s):	Other Evidence:
A.APR.B.2 The Missing Coefficient https://www.illustrativemathematics.org/content-standards/HSA/APR/B/2/tasks/592 A.APR.B.3 Graphing from Factors III https://www.illustrativemathematics.org/content-standards/HSA/APR/B/3/tasks/1657 A.APR.D.6 Combined Fuel Efficiency https://www.illustrativemathematics.org/content-standards/HSA/APR/D/6/tasks/825	Written and Online Assignments Exit Cards Mid Chapter Quizzes End of Chapter Assessments

Stage 3: Learning Plan

Learning Opportunities/Strategies:	Resources:
Turn and talk Student driven activities	PreCalculus, Graphical, Numerical, Algebraic, Seventh Edition, copyright 2007, Finney, Demana, Waits, Kennedy IXL Delta math

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Think, Pair, Share strategy Small group collaboration Videos/apps when appropriate	Edulastic Kahoot Classkick Khan Academy Lesson Presentations and Videos Graphing Calculator Desmos Google Apps for Education LGBT and Disabilities Resources: • LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth • LGBTQ+ Books DEI Resources: • Learning for Justice • GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Khan Academy Project based learning Tablets Challenging problems with higher degree of difficulty Higher order thinking questions Differentiation of pacing and activities Differentiation of learning strategies: visual, auditory, kinetic and cooperative Enrichment and extension Technology connection Practice assignments Puzzle time activities Record and practice journal	Tutoring Tables Graphic organizers Differentiation of learning strategies: visual, auditory, kinetic and cooperative Technology connection Practice Assignments Puzzle time activities Record and practice journal Differentiating the lesson activities Lesson tutorials Skills review handbook	Provide a highly structured, predictable learning environment Provide organizers/study guides Lessons designed to the style of learning that matches the student Cooperative Learning Positive reinforcement Announce test with adequate prep time Lessons presentation available on google classroom Frequent check for understanding Break down task into manageable units One-on-one instruction Tutoring	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

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		Pair student with a high achieving student	

Unit Title: **Functions**

Stage 1: Desired Results

Standards & Indicators:

Interpreting Functions F-IF

A. Understand the concept of a function and use function notation

1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*).
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.*

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

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*⋆
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*⋆
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.⋆

C. Analyze functions using different representations

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.⋆
   a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
   b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
   c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
   d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
   e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

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8. 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.
9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

Building Functions F-BF

A. Build a function that models a relationship between two quantities

1. 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.
   b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*
   c. (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*
2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.⋆

B. Build new functions from existing functions

3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
4. Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) =2 x3 or f(x) = (x+1)/(x–1) for x ≠1. b. (+) Verify by composition that one function is the inverse of another. c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. d. (+) Produce an invertible function from a non-invertible function by restricting the domain.
5. (+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).	With a growth mindset, failure is an important part of success.
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.

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9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).	Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.

Central Idea/Enduring Understanding:	**Essential/Guiding Question:**
Linear relations and functions have straight line graphs. The rate of change of a linear function is known as the slope and can be found using any two points on the line. The equation of a line can be written whenever two points or a point and the slope of the line are known. A line of fit can be used to approximate the relation between domain and range values of a data set that exhibits a linear trend. The inverse of a function can be found by exchanging the domain and range of the function. Functions with a variable under a radical symbol are called radical functions. Two types of radical functions are square root functions and cube root functions. When solving radical equations, first isolate the radical, then raise each side to the power equal to the index of the radical, and finally, solve the resulting equation.	How can we 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? How can we show if f is a function and x is an element of its domain, then f(x) denotes the output corresponding to the input x? How can we show that the graph off is the graph of the equation y = f(x)? How can we compose functions that model a relationship between two quantities? How can we 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? How can we verify by composition that one function is the inverse of another? How can we read values of a function from a table or a graph, given that the function has an inverse? How can we produce an invertible function from a non-invertible function by restricting the domain? How do we graph linear and quadratic functions and show intercepts, maxima, and minima? How do we graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior? How can we graph exponential and logarithmic functions, showing intercepts and end behavior? How can we graph trigonometric functions, showing period, midline, and amplitude? How can we understand the inverse relationship between exponents and logarithms?

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	How can we use this relationship to solve problems involving logarithms and exponents?
Content: Midpoint and Distance Formula Compositions of Functions Inverse Functions Maxima and Minima Polynomial Functions	**Skills(Objectives):** Determine domain and range of a function. Determine if a function is increasing, decreasing or constant. Determine if a function is odd or even. Find combinations and compositions of functions. Find and verify the inverse of a function. Determine the parts of the Cartesian plane. Use the midpoint and distance formulas. Find x and y intercepts. Find maximums and minimums• Test for symmetry Formulate the equation of a circle. Formulate equations of lines and lines parallel and perpendicular to a line. Compose functions that model a relationship between two quantities. 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. Verify by composition that one function is the inverse of another. Read values of an inverse function from a graph or a table, given that the function has an inverse. Produce an invertible function from a non-invertible function by restricting the domain. Find the real and complex zeros of a function. Formulate the standard form of and graph quadratic equations. Graph using translations of functions. Analyze and compare graphs of functions of higher degree polynomials.

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	Graph exponential functions and determine their behaviors. Compute a logarithm value of a number with and without the aid of a calculator. Graph logarithmic functions and determine their behaviors. Explore the properties of the natural exponential function and the natural logarithm. Expand and simplify expressions using the properties of logarithms. Solve exponential and logarithmic equations. Solve real-life problems involving exponential and logarithmic equations Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. Solve exponential and logarithmic equations. Solve real-life problems involving exponential and logarithmic equations.

Interdisciplinary Connections:
Interdisciplinary connections are integrated in each unit with connections to the mathematical practices.

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Stage 2: Assessment Evidence

Performance Task(s):	Other Evidence:
F.BF.A.1b A Sum of Functions https://www.illustrativemathematics.org/content-standards/HSF/BF/A/1/tasks/230 F.BF.B.4a	Written and Online Assignments Exit Cards Mid Chapter Quizzes End of Chapter Assessments End of Unit Common Assessments

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Temperatures in degrees Fahrenheit and Celsius https://www.illustrativemathematics.org/content-standards/HSF/BF/B/4/tasks/501	

Stage 3: Learning Plan

Learning Opportunities/Strategies:	**Resources:**
Turn and talk Student driven activities Think, Pair, Share strategy Small group collaboration Videos/apps when appropriate	PreCalculus, Graphical, Numerical, Algebraic, Seventh Edition, copyright 2007, Finney, Demana, Waits, Kennedy IXL Delta math Edulastic Kahoot Classkick Khan Academy Lesson Presentations and Videos Graphing Calculator Desmos Google Apps for Education LGBT and Disabilities Resources: • LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth • LGBTQ+ Books DEI Resources: • Learning for Justice • GLSEN Educator Resources • Supporting LGBTQIA Youth Resource List • Respect Ability: Fighting Stigmas, Advancing Opportunities • NJDOE Diversity, Equity & Inclusion Educational Resources • Diversity Calendar

Differentiation

*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

High-Achieving Students	**On Grade Level Students**	**Struggling Students**	**Special Needs/ELL**
Khan Academy Project based learning Tablets Challenging problems with higher degree of difficulty Higher order thinking questions Differentiation of pacing and activities Differentiation of learning strategies: visual, auditory, kinetic and	Tutoring Tables Graphic organizers Differentiation of learning strategies: visual, auditory, kinetic and cooperative Technology connection Practice Assignments Puzzle time activities Record and practice	Provide a highly structured, predictable learning environment Provide organizers/study guides Lessons designed to the style of learning that matches the student Cooperative Learning Positive reinforcement	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following::

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cooperative Enrichment and extension Technology connection Practice assignments Puzzle time activities Record and practice journal	journal Differentiating the lesson activities Lesson tutorials Skills review handbook	Announce test with adequate prep time Lessons presentation available on google classroom Frequent check for understanding Break down task into manageable units One-on-one instruction Tutoring Pair student with a high achieving student	Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

Unit Title: **The Complex Number System**

Stage 1: Desired Results

Standards & Indicators:

The Complex Number System N -CN

A. Perform arithmetic operations with complex numbers.

1. Know there is a complex number i such that i^2 = –1, and every complex number has the form a + bi with a and b real.

2. Use the relation i^22 = –1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

B. Represent complex numbers and their operations on the complex plane.

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.

5. (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, (-1 + √3i)3 = 8 because (-1+ √3i) has modulus 2 and argument 120°.

6. (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

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C. Use complex numbers in polynomial identities and equations.
7. Solve quadratic equations with real coefficients that have complex solutions.

8. (+) Extend polynomial identities to the complex numbers. For example, rewrite x2 + 4 as (x + 2i)(x – 2i).

9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).	With a growth mindset, failure is an important part of success.
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).	Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.

Central Idea/Enduring Understanding:

Complex numbers are numbers that consist of two parts ; a real number and an imaginary number. Complex numbers are the building blocks of more intricate math, such as algebra. They can be applied to many aspects of real life, especially in electronics and electromagnetism.

Essential/Guiding Question:

How can we solve quadratic equations with real coefficients that have complex solutions?

How can we extend polynomial identities to the complex numbers?

How can we learn the Fundamental Theorem of Algebra and show that it is true for quadratic polynomials?

Content:
Quadratic equations
Polynomial Identities
Fundamental Theorem of Algebra
Complex Numbers

Skills(Objectives):
Solve quadratic equations with real coefficients that have complex solutions.

Extend polynomial identities to the complex numbers. For example, rewrite x2 + 4 as (x + 2i}(x - 2i}.

Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Interdisciplinary Connections:
Interdisciplinary connections are integrated in each unit with connections to the mathematical practices.

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1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
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4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
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Stage 2: Assessment Evidence

Performance Task(s):

N.CN.7
Completing the square
http://tasks.illustrativemathematics.org/content-standards/HSN/CN/C/7/tasks/1690

Other Evidence:
Written and Online Assignments
Exit Cards
Mid Chapter Quizzes
End of Chapter Assessments
End of Unit Common Assessments

Stage 3: Learning Plan

Learning Opportunities/Strategies:

Turn and talk

Student driven activities

Think, Pair, Share strategy

Small group collaboration

Videos/apps when appropriate

Resources:
PreCalculus, Graphical, Numerical, Algebraic, Seventh Edition, copyright 2007, Finney, Demana, Waits, Kennedy
IXL
Delta math
Edulastic
Kahoot
Classkick
Khan Academy
Lesson Presentations and Videos
Graphing Calculator
Desmos
Google Apps for Education

LGBT and Disabilities Resources:

- LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth
- LGBTQ+ Books

DEI Resources:

- Learning for Justice
- GLSEN Educator Resources
- Supporting LGBTQIA Youth Resource List
- Respect Ability: Fighting Stigmas, Advancing Opportunities
- NJDOE Diversity, Equity & Inclusion Educational Resources
- Diversity Calendar

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Unit Title: **Trigonometric Functions, Similarity, Right Triangles, and Trigonometry**

Stage 1: Desired Results

Standards & Indicators:

Trigonometric Functions F-TF

A. Extend the domain of trigonometric functions using the unit circle

1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
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.
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.
4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

B. Model periodic phenomena with trigonometric functions

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5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.★
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.
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.★

C. Prove and apply trigonometric identities

8. Prove the Pythagorean identity sin2 (θ) + cos2 (θ) = 1 and use it to find sin(θ), cos(θ),or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.
9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Similarity, Right Triangles, and Trigonometry G-SRT

C. Define trigonometric ratios and solve problems involving right triangles

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.

7. Explain and use the relationship between the sine and cosine of complementary angles.

8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

D. Apply trigonometry to general triangles

9. (+) Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.

10. (+) Prove the Laws of Sines and Cosines and use them to solve problems.
11. (+) Understand and apply 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).

Career Readiness, Life Literacies and Key Skills

Standard	Performance Expectations	Core Ideas
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).	With a growth mindset, failure is an important part of success.
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4,	Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.

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	6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).	

Central Idea/Enduring Understanding:	**Essential/Guiding Question:**
Trigonometry is a branch of mathematics that studies relationships between the sides and angles of triangles. Trigonometry is found all throughout geometry, as every straight-sided shape may be broken into as a collection of triangles. Trigonometric functions are a way to relate the lengths of the three sides of a right triangle to the interior angles of the triangle.	How can we understand the radian measure of an angle as the length of the arc on the unit circle subtended by the angle? How can we 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? How can we use special triangles to determine geometrically the values of sine, cosine, tangent for n/3, n/4 and n/6, and use the unit circle to express the values of sine, cosine, and tangent for n-x, n+x, and 2n-x in terms of their values for x, where x is any real number? How can we use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions? How can we 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? How can we simplify expressions involving trigonometric inverse functions? How can we determine reference angles? How can we 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? How can we explain and use the relationship between the sine and cosine of complementary angles? How can we prove the Pythagorean identity sin2(8) + cos2(8) = 1 and use it to find sin(8), cos(8), or tan(8) given sin(8), cos(8), or tan(8) and the quadrant of the angle? How can we prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems?
Content:	**Skills(Objectives):**
Radian and Degree measures Trigonometric functions and equations Arc Length, Radius and Central Angle Similarity of triangles Sine, Cosine, Tangent	Convert from radian to degree measure and vice versa. Draw angles with radian and degree measures. Find arc length, radius and central angle (theta).

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	Use the unit circle to find trigonometric values of angles. Solve real-life problems using the trigonometric functions. Find the value of any angle using the trigonometric functions Use the calculator to find arcsines, arccosines, and arctangents. Simplify expressions involving trigonometric inverse functions. Determine reference angles 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. Understand that by similarity, side ratios in right triangles are properties of the angles of the triangles. Define and solve problems involving right triangle Find two angles given a specific trigonometric value. Graph the sine, cosine and tangent function. Explain and use the relationship between the sine and cosine of complementary angles. Understand and apply definitions of trigonometric ratios for acute angles. Use trigonometric identities to simplify, factor, multiply, add and subtract trigonometric expressions. Use trigonometric identities to verify trigonometric equations. Solve trigonometric equations.

Interdisciplinary Connections:

Interdisciplinary connections are integrated in each unit with connections to the mathematical practices.

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

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Stage 2: Assessment Evidence

Performance Task(s):

F.TF.C.9
Sum and Difference angle formulas
http://tasks.illustrativemathematics.org/content-standards/HSF/TF/C/9/tasks/1116

G.SRT.C.6
Defining Trigonometric Ratios
http://tasks.illustrativemathematics.org/content-standards/HSG/SRT/C/6/tasks/1635

Other Evidence:
Written and Online Assignments
Exit Cards
Mid Chapter Quizzes
End of Chapter Assessments
End of Unit Common Assessments

Stage 3: Learning Plan

Learning Opportunities/Strategies:

Turn and talk

Student driven activities

Think, Pair, Share strategy

Small group collaboration

Videos/apps when appropriate

Resources:
PreCalculus, Graphical, Numerical, Algebraic, Seventh Edition, copyright 2007, Finney, Demana, Waits, Kennedy
IXL
Delta math
Edulastic
Kahoot
Classkick
Khan Academy
Lesson Presentations and Videos
Graphing Calculator
Desmos
Google Apps for Education

LGBT and Disabilities Resources:

- LGBTQ-Inclusive Lesson & Resources by Garden State Equality and Make it Better for Youth
- LGBTQ+ Books

DEI Resources:

- Learning for Justice
- GLSEN Educator Resources
- Supporting LGBTQIA Youth Resource List
- Respect Ability: Fighting Stigmas, Advancing Opportunities
- NJDOE Diversity, Equity & Inclusion Educational Resources
- Diversity Calendar

Differentiation
*Please note: Teachers who have students with 504 plans that require curricular accommodations are to refer to Struggling and/or Special Needs Section for differentiation

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High-Achieving Students	On Grade Level Students	Struggling Students	Special Needs/ELL
Khan Academy Project based learning Tablets Challenging problems with higher degree of difficulty Higher order thinking questions Differentiation of pacing and activities Differentiation of learning strategies: visual, auditory, kinetic and cooperative Enrichment and extension Technology connection Practice assignments Puzzle time activities Record and practice journal	Tutoring Tables Graphic organizers Differentiation of learning strategies: visual, auditory, kinetic and cooperative Technology connection Practice Assignments Puzzle time activities Record and practice journal Differentiating the lesson activities Lesson tutorials Skills review handbook	Provide a highly structured, predictable learning environment Provide organizers/study guides Lessons designed to the style of learning that matches the student Cooperative Learning Positive reinforcement Announce test with adequate prep time Lessons presentation available on google classroom Frequent check for understanding Break down task into manageable units One-on-one instruction Tutoring Pair student with a high achieving student	Any student requiring further accommodations and/or modifications will have them individually listed in their 504 Plan or IEP. These might include, but are not limited to: breaking assignments into smaller tasks, giving directions through several channels (auditory, visual, kinesthetic, model), and/or small group instruction for reading/writing ELL supports should include, but are not limited to, the following:: Extended time Provide visual aids Repeated directions Differentiate based on proficiency Provide word banks Allow for translators, dictionaries

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Pacing Guide

Pre Calculus Honors	PreCalculus, Graphical, Numerical, Algebraic, Seventh Edition,	Standards
UNIT 1 Rational and Irrational Expressions; Polynomials (22 Days)	**CHAPTERS** 1: (11 Days) 2: (11 Days)	A.APR.A.1 A.APR.B.2 A.APR.B.3 A.APR.C.4 A.APR.C.5 A.APR.D.6 A.APR.D.7
UNIT 2 Functions (22 Days)	**CHAPTERS** 3: (10 Days) 4: (12 Days)	F.IF.A.1 F.IF.A.2 F.IF.A.3 F.IF.B.4 F.IF.B.5 F.IF.B.6 F.IF.C.7 F.IF.C.8 F.IF.C.9 F.BF.A.1 F.BF.A.2 F.BF.B.3 F.BF.B.4 F.BF.B.5
UNIT 3 The Complex Number System (10 Days)	**CHAPTERS** 5: (10 Days)	N.CN.A.1 N.CN.A.2 N.CN.A.3 N.CN.B.4 N.CN.B.5 N.CN.B.6 N.CN.C.7 N.CN.C.8 N.CN.C.9

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UNIT 4 Trigonometric Functions, Similarity, Right Triangles, and Trigonometry (32 Days)	**CHAPTERS** 6: (16 Days) 7: (16 Days)	F.TF.A.1 F.TF.A.2 F.TF.A.3 F.TF.A.4 F.TF.B.5 F.TF.B.6 F.TF.B.7 F.TF.C.8 F.TF.C.9