PreCalculus Curriculum

Course Description: Students enrolled in PreCalculus extensively study operations on functions including solving equations, graphing, and finding domain and range. Specific functions to be studied include polynomials, rational, exponential, logarithmic, and trigonometric functions. Students will also apply their knowledge and skills to the study of analytic geometry.

In Units 1 through 4, students will solidify their understanding of trigonometric expressions and equations as well as learn how to find any angle on the unit circle and apply knowledge of those angles to solve situations. Students will also use their knowledge of algebra to manipulate different equations and identities to whatever form is wanted or beneficial.

In Units 5 through 9, students will learn to simplify and evaluate expressions, solve equations and check solutions, and model and describe these new functions. They will apply these models to new situations.

As students encounter challenging problems, and practice asking for help and a willingness to learn from others, they build the social emotional learning competencies of self-management, self awareness, relationship skills, and social awareness.

*Honors Precalculus follows the same course sequence as Precalculus with difference in depth and rigor. Additional topics are embedded in various units to support curriculum standards in future honors and AP courses. These topics include (but are not limited to) graphing reciprocal trigonometry, Heron's Formula, and conic sections, etc.

Grades: 10th - 12th

Course Priority Standards:

- G.SRT.B.4: Prove theorems involving similarity. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
- G.SRT.C.7: Define trigonometric ratios, solve problems involving right triangles. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles.
- A2.NQ.A.3: Extend and use the relationship between rational exponents and radicals. Add, subtract, multiply and divide radical expressions.
- A2.IF.A.1: Use and interpret functions: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
- A2.IF.A.2: Use and interpret functions. Translate between equivalent forms of functions.
- A2.BF.A.1: Create new functions from existing functions. Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).
- A2.BF.A.2: Create new functions from existing functions. Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.

- A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
- A2.APR.A.1: Perform operations on polynomials and rational expressions. Extend the knowledge of factoring to include factors with complex coefficients.
- A2.NQ.B.6: Use complex numbers. Add, subtract, multiply and divide complex numbers.
- A2.NQ.B.5: Use complex numbers. Represent complex numbers.
- A2.SSE.A.2: Define and use logarithms. Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.
- A2.NQ.A.4: Extend and use the relationship between rational exponents and radicals. Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.
- A2.NQ.A.2: Extend and use the relationship between rational exponents and radicals. Create and recognize equivalent expressions involving radical and exponential forms of expressions.
- A2.NQ.A.1: Extend and use the relationship between rational exponents and radicals. Extend the system of powers and roots to include rational exponents.
- A2.SSE.A.3: Define and use logarithms. Use properties of logarithms to solve equations or find equivalent expressions.
- A2.SSE.A.1: Define and use logarithms. Develop the definition of logarithms based on properties of exponents.

Course Essential Questions:

- How do we use trigonometry and special right triangles to find missing pieces of triangles and evaluate expressions?
- How do we evaluate trigonometric expressions using the unit circle to find exact values?
- How do we graph sine, cosine, and tangent functions?
- How do we analyze and identify key characteristics of different function types?
- Which method is most efficient when solving a quadratic equation?
- How do the restrictions on a square root function influence inverses for both quadratic and square root functions?
- How do we use the properties of logarithms to simplify or solve exponential and logarithmic situations?
- How does the fundamental theorem of algebra relate to x-intercepts?
- How does the degree of a polynomial function impact end behavior, x-intercepts, and relative extrema?
- How do we identify the domain of any function?
- How do we know if a domain restriction is an asymptote versus a point of discontinuity?

Course Enduring Understandings:

- Real world situations can be represented symbolically and graphically.
- The number of solutions is determined by the function used to model the situation.
- Functions are modeled from their parent functions and transformations.
- Algebraic operations can be used to simplify trigonometric expressions and verify trigonometric identities
- All trigonometric equations can be solved with angles within one revolution of a circle (with repeated solutions with multiple rotations).

Course Essential Vocabulary: adjacent, altitude, ambiguous case, angles of elevation/depression/inclination, arc length, sine, cosine, tangent, secant, cosecant, cotangent, coterminal, laws of sines/cosines, radian, rationalize, reference angles, sector area, standard position, terminal side,

amplitude, arc length, asymptote, central angle, clockwise, counterclockwise, period, phase shift, quadrant, reference angle, reflection, sector area, shift, sohcahtoa, terminal point, trigonometry, unit circle, common denominator, difference, double angle, factor, simplify, substitute, sum, trigonometry, verify, equation, evaluate, expression, extraneous solution, inverse, reciprocal, right triangle, simplify, unit circle, 1-to-1, composite, decreasing, difference quotient, dilation, even, function, function notation, horizontal, horizontal line test, increasing, inverse, odd, range, shift, slope, symmetry, transformation, translation, vertical line test, complete the square, degree, inequality, maximum, minimum, quadratic, piecewise function, radical, square root, vertex, argument, base, compounding interest, condense, expand, exponential decay, exponential equation, exponential form, exponential function, exponential growth, extraneous solution, horizontal asymptote, logarithmic equation, logarithmic form, logarithmic function, natural logarithm, vertical asymptote, roots, x-intercepts, y-intercept, zeros, factor, domain, real, complex, extrema, degree, synthetic division, conjugate, end behavior, hole, rational, slant, oblique

Course Resources & Materials

- DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 1	**Trigonometric Functions of Angles (4.5 Weeks)**
Unit 1 Enduring Understandings	Properties and formulas of triangles and sectors will be reviewed.
Unit 1 Essential Questions	• How do we use trigonometry and special right triangles to find missing pieces of triangles and evaluate expressions? • How do we find sector area and arc length using both degrees?
Unit 1 Student Learning Goals	• Students will learn to solve a triangle using SOH-CAH-TOA, Pythagorean Theorem, and Special Right Triangles. • Students will learn to solve a triangle using Law of Sines. • Students will learn to solve a triangle using Law of Cosines. • Students will find the area of a triangle using ½ $ab\sin C$. • Students will find length of an arc of a triangle (using degrees). • Students will find sector area of a triangle (using degrees). • Students will evaluate expressions by applying right triangle trigonometry in any quadrant. • Students will apply trigonometry and special right triangles to real applications.
Unit 1 Vocabulary	adjacent, altitude, ambiguous case, angles of elevation/depression/inclination, arc length, sine, cosine, tangent, secant, cosecant, cotangent, coterminal, laws of sines/cosines, radians, rationalize, reference angles, sector area, standard position, terminal side

Unit 1 Missouri Learning Standards	G.SRT.C.5: Define trigonometric ratios, solve problems involving right triangles. Understand that side ratios in right triangles define the trigonometric ratios for acute angles.
	G.SRT.C.6: Define trigonometric ratios, solve problems involving right triangles. Explain and use the relationship between the sine and cosine of complementary angles.
	G.SRT.C.7: Define trigonometric ratios, solve problems involving right triangles. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles.
	G.SRT.C.8: Derive the formula A = 1/2 ab sin(C) for the area of a triangle.
	G.C.B.4: Derive the formula for the length of an arc of a circle. (Degrees)
	G.C.B.5: Derive the formula for the area of a sector of a circle. (Degrees)
Unit 1 Common Core State Standards	HSG-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.
	HSG-SRT.C.7- Explain and use the relationship between the sine and cosine of complementary angles.
	HSG-SRT.C.8- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
	HSG-SRT.D.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.
	HSG-SRT.D.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).
Unit 1 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 1	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 2	**Unit Circle and Radians (5 weeks)**

Unit 2 Enduring Understandings	● All angles on the coordinate plane can be represented by their reference angles multiple way (radians, degrees, coterminal angles, etc). ● The unit circle helps with exact value of common trig situations. ● Waves are represented by sin and cosine graphs.
Unit 2 Essential Questions	● How do we use reference angles to analyze any given angle and its coterminal angles in both degrees and radians? ● How do we evaluate trigonometric expressions using the unit circle to find exact values? ● How do we graph sine, cosine, and tangent functions? ● How do we find sector area and arc length using both degrees?
Unit 2 Student Learning Goals	● Students will understand the difference between degrees and radians and convert between them. ● Students will use radians to measure angles and identify terminal points. ● Students will find length of an arc of a triangle (using degrees). ● Students will find sector area of a triangle (using degrees). ● Students will use reference angles and coterminal angles to evaluate trig expressions. ● Students will discover the unit circle using special right triangles and use it to evaluate trig expressions. ● Students will graph sine, cosine, and tangent functions with transformations.
Unit 2 Vocabulary	amplitude, arc length, asymptote, central angle, clockwise, cosecant, cosine, cotangent, coterminal, counterclockwise, period, phase shift, quadrant, radian, reciprocal, reference angle, reflection, secant, sector area, shift, sine, SOHCAHTOA, tangent, terminal point, trigonometry, unit circle
Unit 2 Missouri Learning Standards	G.GPE.A.1: Derive the equation of a circle.
	G.SRT.C.5: Define trigonometric ratios, solve problems involving right triangles. Understand that side ratios in right triangles define the trigonometric ratios for acute angles.
	G.SRT.C.6: Define trigonometric ratios, solve problems involving right triangles. Explain and use the relationship between the sine and cosine of complementary angles.
	G.C.B.4: Derive the formula for the length of an arc of a circle. (Radians)
	G.C.B.5: Derive the formula for the area of a sector of a circle. (Radians)
Unit 2 Common Core State Standards	HSF-TF.A.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
	HSF-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.

	HSF-TF.A.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π–x, π+x, and 2π–x in terms of their values for x, where x is any real number.
	HSF-TF.A.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
Unit 2 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 2	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 3	**Analytic Trigonometry - Simplifying Expressions and Verifying Identities (6 weeks)**
Unit 3 Enduring Understandings	• Algebraic operations can be used to simplify trigonometric expressions and verify trigonometric identities. • There are multiple ways to represent the same trigonometric identity.
Unit 3 Essential Questions	• How do we use algebra to simplify trigonometric expressions and verify trigonometric identities? • How do we use trigonometric identities to simplify expressions and verify identities?
Unit 3 Student Learning Goals	• Students will perform operations and factor trigonometric expressions. • Students will use trigonometric identities to simplify and factor expressions. • Students will verify trigonometric identities and equations using identities. • Students will be able to simplify and evaluate trigonometric expressions using sum and difference and double angle identities.
Unit 3 Vocabulary	common denominator, difference, double angle, factor, rationalize, reciprocal, simplify, substitute, sum, trigonometry, unit circle, verify
Unit 3 Missouri Learning Standards	A1.APR.A.1: Add, subtract and multiply polynomials, and understand that polynomials follow the same general rules of arithmetic and are closed under these operations.
	A1.CED.A.4: Solve literal equations and formulas for a specified variable that highlights a quantity of interest.
	A2.APR.A.1: Perform operations on polynomials and rational expressions. Extend the knowledge of factoring to include factors with complex coefficients.

Unit 3 Common Core State Standards	HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R
	HSF-TF.C.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.
	HSF-TF.C.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
Unit 3 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 3	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 4	**Inverse Trig and Solving Trigonometric Equations (3.5 weeks)**
Unit 4 Enduring Understandings	• All trigonometric equations can be solved with angles within one revolution of a circle (with repeated solutions with multiple rotations). • Trigonometric identities can make it easier to solve for solutions. • Trigonometric equations can have extraneous solutions.
Unit 4 Essential Questions	• When do we use identities to solve trigonometric equations? • When does a trigonometric equation have multiple solutions? • When does a trigonometric equation have extraneous solutions?
Unit 4 Student Learning Goals	• Students will evaluate inverse trigonometric expressions (including with identities). • Students will solve trigonometric equations with identities, factoring, and multiple rotations.
Unit 4 Vocabulary	domain, equation, evaluate, expression, extraneous solution, factor, inverse, reciprocal, right triangle, simplify, trigonometry, unit circle
Unit 4 Missouri Learning Standards	A1.REI.A.1: Understand solving equations as a process, and solve equations and inequalities in one variable. Explain how each step taken when solving an equation or inequality in one variable creates an equivalent equation or inequality that has the same solution(s) as the original.
	A1.REI.A.2b: Understand solving equations as a process, and solve equations and inequalities in one variable. Solve problems involving quadratic equation: b.Derive the quadratic formula.

	A1.REI.A.2c: Understand solving equations as a process, and solve equations and inequalities in one variable. Solve problems involving quadratic equations: c.Analyze different methods of solving quadratic equations.
Unit 4 Common Core State Standards	HSG-SRT.C.8- Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
	HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R
	HSF-TF.C.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.
	HSF-TF.C.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
Unit 4 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 4	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 5	**Intro to Functions (3 weeks)**
Unit 5 Enduring Understandings	• Functional relationships between independent and dependent variables can be used to model real-world examples. • Situations can be represented using different categories of functions. • Functions can have limitations such as domain and range.
Unit 5 Essential Questions	• How do we analyze and identify key characteristics of different function types? • Can there be constraints on a function? If so, how would they be calculated? • How do we know if a function has an inverse, and how do we find that inverse function?
Unit 5 Student Learning Goals	• Students will analyze relations to determine domain, range, and if they are functions. • Students will be able to graph the parent functions of linear, quadratic, square root, cube root, absolute value, polynomial, exponential, and logarithmic functions alone and in piecewise functions. • Students will recognize and graph vertical and horizontal transformations. • Students will evaluate function notation and function composition. • Students will classify functions as one-to-one and derive its inverse. • Students will determine if two functions are inverses of each other. • Students will evaluate the difference quotient for constant, linear, quadratic, and rational functions.

Unit 5 Vocabulary	1-to-1, composite, decreasing, difference quotient, dilation, domain, end behavior, even, extrema, function, function notation, horizontal, horizontal line test, increasing, inverse, maximum, minimum, odd, range, reflection, shift, slope, symmetry, transformation, translation, vertical line test, intercepts
Unit 5 Missouri Learning Standards	A2.IF.A.1: Use and interpret functions: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
	A2.IF.A.2: Use and interpret functions. Translate between equivalent forms of functions.
	A2.BF.A.1: Create new functions from existing functions. Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary).
	A2.BF.A.2: Create new functions from existing functions. Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.
	A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
	A2.REI.A.1 Create and solve equations and inequalities, including those that involve absolute value.
Unit 5 Common Core State Standards	HSF-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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
	HSF-IF.B.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.
	HSF-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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
	HSF-BF.A.1 Write a function that describes a relationship between two quantities. 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.

	HSF-BF.B.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.
	HSF-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. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
Unit 5 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 5	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 6	**Quadratic and Square Root Functions (4 weeks)**
Unit 6 Enduring Understandings	• All quadratic equations have solutions, either real or complex. • Operations of complex number always simplify to real or complex expressions. • All quadratic expressions can be factored.
Unit 6 Essential Questions	• How does understanding how to find the vertex of a quadratic function help in making decisions in real-life applications? • Which method is most efficient when solving a quadratic equation? • How do the restrictions on a square root function influence inverses for both quadratic and square root functions?
Unit 6 Student Learning Goals	• Students will graph and analyze quadratic, square root functions, and piecewise functions. • Students will be able to write and solve quadratic equations and inequalities. • Students will be able to find the inverse of square root functions. • Students will be able to evaluate the difference quotient for quadratic and square root functions. • Students will be able to graph functions that include quadratic terms inside of square roots.
Unit 6 Vocabulary	complete the square, degree, extrema, inequality, maximum, minimum, quadratic, piecewise function, radical, rational, rationalize, square root, vertex
Unit 6 Missouri Learning Standards	A2.FM.A.1: Use functions to model real-world problems. Create functions and use them to solve applications of quadratic and exponential function model problems.

	A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
	A1.REI.A.2b: Understand solving equations as a process, and solve equations and inequalities in one variable. Solve problems involving quadratic equation: b.Derive the quadratic formula.
	A1.REI.A.2c: Understand solving equations as a process, and solve equations and inequalities in one variable. Solve problems involving quadratic equations: c.Analyze different methods of solving quadratic equations.
Unit 6 Common Core State Standards	HSF-BF.A.1 Write a function that describes a relationship between two quantities. 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.
	HSF-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. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
	HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
	HSA-REI.B.4 Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (xp)2 = q that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.
Unit 6 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 6	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 7	**Exponential and Logarithmic Functions (4.5 weeks)**

Unit 7 Enduring Understandings	● Real world situations can be represented by exponential graphs. ● A radical expression can be written using rational exponents. ● The structure of a exponential function can determine a strategy used to find solutions. ● A logarithm is an exponent. ● A logarithmic equation can be written in exponential form. ● The structure of a logarithmic function can determine a strategy used to find solutions.
Unit 7 Essential Questions	● How do we use the properties of logarithms to simplify or solve exponential and logarithmic situations? ● How does the range of an exponential function affect the domain restrictions of logarithmic functions? ● What real-world applications can be solved using exponential and logarithmic functions?
Unit 7 Student Learning Goals	● Students will graph and analyze exponential and logarithmic functions. ● Students will create and solve exponential equations for exponential applications. ● Students will be able to graph and find inverses for exponential and logarithmic functions. ● Students will use properties of exponents and logarithms to simplify, evaluate or solve.
Unit 7 Vocabulary	argument, asymptote, base, compounding interest, condense, expand, exponential decay, exponential equation, exponential form, exponential function, exponential growth, extraneous solution, horizontal asymptote, logarithmic equation, logarithmic form, logarithmic function, natural logarithm, vertical asymptote
Unit 7 Missouri Learning Standards	A2.FM.A.1: Use functions to model real-world problems. Create functions and use them to solve applications of quadratic and exponential function model problems.
	A2.BF.A.3: Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions.
	A2.SSE.A.2: Define and use logarithms. Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.
	A2.NQ.A.4: Extend and use the relationship between rational exponents and radicals. Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.
	A2.NQ.A.2: Extend and use the relationship between rational exponents and radicals. Create and recognize equivalent expressions involving radical and exponential forms of expressions.
	A2.NQ.A.1: Extend and use the relationship between rational exponents and radicals. Extend the system of powers and roots to include rational exponents.

	A2.SSE.A.3: Define and use logarithms. Use properties of logarithms to solve equations or find equivalent expressions.
	A2.SSE.A.1: Define and use logarithms. Develop the definition of logarithms based on properties of exponents.
	A1.NQ.A.2: Extend and use properties of rational exponents. Rewrite expressions involving radicals and rational exponents using the properties of exponents. Limit to rational exponents with a numerator of 1.
Unit 7 Common Core State Standards	HSF-BF.A.1 Write a function that describes a relationship between two quantities. 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.
	HSF-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. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
	HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
	HSF-LE.A.4 For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
	HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.
	HSA-REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
	HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
	HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
Unit 7 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 7	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 8	Polynomial Functions (4.5 weeks)
Unit 8 Enduring Understandings	• All polynomial equations have solutions, either real or complex. • Polynomial division can be used to factor expressions. • The fundamental theorem of algebra determines the number of solutions. • The degree of a polynomial determines its shape and end behavior.
Unit 8 Essential Questions	• How does the fundamental theorem of algebra relate to x-intercepts? • How does the degree of a polynomial function impact end behavior, x-intercepts, and relative extrema? • What is the relationship between factors, x-intercepts, and roots (both real and complex)?
Unit 8 Student Learning Goals	• Students will factor polynomial expressions with or without division. • Students will solve polynomial equations with real and complex roots. • Students will graph and analyze polynomial functions. • Students will create polynomial functions.
Unit 8 Vocabulary	roots, x-intercepts, y-intercept, zeros, factor, end behavior, domain, real, complex, extrema, maximum, minimum, degree, synthetic division, conjugate, function, quadratic
Unit 8 Missouri Learning Standards	A2.APR.A.1: Perform operations on polynomials and rational expressions. Extend the knowledge of factoring to include factors with complex coefficients.
	A2.NQ.B.6: Use complex numbers. Add, subtract, multiply and divide complex numbers.
	A2.NQ.B.5: Use complex numbers. Represent complex numbers.
	A2.APR.A.5: Perform operations on polynomials and rational expressions. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial.
	A2.NQ.B.7: Use complex numbers. Know and apply the Fundamental Theorem of Algebra.
	A2.APR.A.2: Perform operations on polynomials and rational expressions. Understand the Remainder Theorem and use it to solve problems.
Unit 8 Common Core State Standards	HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it. For example, see x4– y4 as (x2)2 –(y2)2, thus recognizing it as a difference of squares that can be factored as (x2– y2)(x2+ y2).
	HSA-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.

	HSN-CN.C.8 Extend polynomial identities to the complex numbers. For example, rewrite x2+4 as (x +2i)(x –2i).
	HSN-CN.A.2 Use the relation i2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
	HSN-CN.A.1 Know there is a complex number i such that i2 = -1, and every complex number has the form a + bi with a and b real.
	HSN-CN.C.9 Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
	HSA-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).
	HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple case sand using technology for more complicated cases. 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. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
Unit 8 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 8	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials

Unit 9	**Rational Functions (3 weeks)**
Unit 9 Enduring Understandings	• Operations can be performed on rational expressions. • Rational equations may have extraneous solutions. • The denominator determines restrictions on the domain.
Unit 9 Essential Questions	• Which asymptotes can functions cross? • How do we identify the domain of any function? • How do we know if a domain restriction is an asymptote versus a point of discontinuity? • How can intercepts and asymptotes be used to model a rational function?
Unit 9 Student	• Students will perform operations on rational expressions.

Learning Goals	● Students will graph and analyze rational functions with multiple asymptotes and oblique asymptotes. ● Students will create and write rational functions from graphs or to fit restrictions. ● Students will solve rational equations and check for extraneous solutions.
Unit 9 Vocabulary	roots, x-intercepts, y-intercept, zeros, factor, end behavior, asymptote, domain, real, complex, extrema, maximum, minimum, degree, synthetic division, conjugate, hole, function, rational, quadratic, slant, oblique
Unit 9 Missouri Learning Standards	A2.APR.A.4: Perform operations on polynomials and rational expressions. Add, subtract, multiply and divide rational expressions.
	A2.REI.A.2: Solve equations and inequalities. Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.
	A2.IF.A.1: Use and interpret functions: Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.
	A2.APR.A.3: Perform operations on polynomials and rational expressions. Find the least common multiple of two or more polynomials.
Unit 9 Common Core State Standards	HSA-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.
	HSA-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.
	HSA-REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
	HSF-IF.B.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.
	HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple case sand using technology for more complicated cases. d. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. e. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. f. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

	HSF-IF.C.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. b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)t , y = (0.97)t , y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth or decay.
	HSF-IF.C.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.
	HSA-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.
Unit 9 Assessments	PLC created and revised annually
Curricular Resources Utilized in Unit 9	DeltaMath, Desmos, ACT prep book, Math Medic, and teacher created materials