

Haddon Township High School
Course Overview

Subject Area: Math
Course Name: Pre-Calculus

Summary: This course builds on the foundation established in Algebra II. Major concepts include: polynomial functions, functions, exponents & logarithms, trigonometric functions, equations & applications, triangle trigonometry, trigonometric. The use of graphing calculators is an integral part of the curriculum.

Unit Title	Student Learning Target	Standards	Resources	Assessment
Unit 1 Linear and Quadratic Functions	<p><i>Students will ...</i></p> <ul style="list-style-type: none"> • be able to find the intersection of two lines • be able to find the length of a segment • be able to find the coordinates of the mid-point of a segment • find the solution(s) for linear and quadratic functions. <p>graph a linear and a quadratic function.</p>	<p>Interpret the structure of expressions.</p> <ul style="list-style-type: none"> • A-SSE.1. Interpret expressions that represent a quantity in terms of its context. <ul style="list-style-type: none"> ○ Interpret parts of an expression, such as terms, factors, and coefficients. ○ Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1+r)^n$ as the product of P</i> 	smartboard, computer, textbook, graphing calculator	Teacher generated quizzes and tests

		<p style="text-align: center;"><i>and a factor not depending on P.</i></p> <ul style="list-style-type: none"> • A-SSE.2. Use the structure of an expression to identify ways to rewrite it. <i>For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</i> <p>Write expressions in equivalent forms to solve problems.</p> <ul style="list-style-type: none"> • A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. □ <ul style="list-style-type: none"> ○ a. Factor a quadratic expression to reveal the zeros of the function it defines. ○ b. Complete the square in a quadratic expression to 		
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		<p>reveal the maximum or minimum value of the function it defines.</p> <p>Create equations that describe numbers or relationships.</p> <ul style="list-style-type: none">• A-CED.1. Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i>• A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. <p>Understand solving equations as a process of reasoning and explain the reasoning.</p> <ul style="list-style-type: none">• A-REI.1. Explain each step in solving a simple		
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		<p>equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.</p> <ul style="list-style-type: none">• A-REI.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. <p>Solve equations and inequalities in one variable.</p> <ul style="list-style-type: none">• A-REI.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.• A-REI.4. Solve quadratic equations in one variable.<ul style="list-style-type: none">◦ Use the method of completing the square to transform any quadratic equation in x into an equation of the		
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		<p>form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.</p> <ul style="list-style-type: none"> ○ Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b. <p>Perform arithmetic operations with complex numbers.</p> <ul style="list-style-type: none"> • N-CN.1. Know there is a complex number i such that $i^2 = -1$, and every 		
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		<p>complex number has the form $a + bi$ with a and b real.</p> <ul style="list-style-type: none"> • N-CN.2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. • N-CN.3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. <p>Represent complex numbers and their operations on the complex plane.</p> <ul style="list-style-type: none"> • N-CN.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. • N-CN.5. (+) Represent addition, subtraction, 		
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		<p>multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. <i>For example, $(-1 + \sqrt{3}i)^3 = 8$ because $(-1 + \sqrt{3}i)$ has modulus 2 and argument 120°.</i></p> <ul style="list-style-type: none"> • N-CN.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. <p>Use complex numbers in polynomial identities and equations.</p> <ul style="list-style-type: none"> • N-CN.7. Solve quadratic equations with real coefficients that have complex solutions. • N-CN.8. (+) Extend polynomial identities to the complex numbers. <i>For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$.</i> 		
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		<ul style="list-style-type: none"> N-CN.9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. 		
Unit 2 Polynomial Functions	<p><i>Students will ...</i></p> <ul style="list-style-type: none"> identify, evaluate and determine the zeros of a polynomial function use synthetic division and apply the remainder and factor theorems graph a polynomial function and to determine an equation for a graph be able to determine max and min points of a graph <p>to solve polynomial equations using various methods of factoring, and the rational root theorem</p>	<p>Write expressions in equivalent forms to solve problems.</p> <ul style="list-style-type: none"> A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. □ <ul style="list-style-type: none"> a. Factor a quadratic expression to reveal the zeros of the function it defines. <p>Understand the relationship between zeros and factors of polynomials.</p> <ul style="list-style-type: none"> A-APR.2. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and 	smartboard, computer, textbook, graphing calculator	Teacher generated quizzes and tests

		<p>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 $p(x)$.</p> <ul style="list-style-type: none"> • A-APR.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. <p>Use polynomial identities to solve problems.</p> <ul style="list-style-type: none"> • A-APR.4. Prove polynomial identities and use them to describe numerical relationships. <i>For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.</i> • A-APR.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 		
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		<p>Pascal's Triangle.¹</p> <p>Rewrite rational expressions.</p> <ul style="list-style-type: none"> • A-APR.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.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. <p>Understand the concept of a function and use function notation.</p>		
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		<ul style="list-style-type: none">• F-IF.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.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.3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. <i>For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$</i>		
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		<p style="text-align: center;"><i>for $n \geq 1$.</i></p> <p>Interpret functions that arise in applications in terms of the context.</p> <ul style="list-style-type: none"> • F-IF.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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> □ • F-IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>For example, if the function $h(n)$ gives the number of person-hours it</i> 		
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		<p><i>takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.</i> □</p> <ul style="list-style-type: none"> • F-IF.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. □ 		
Unit 3	<p><i>Students will ...</i></p> <ul style="list-style-type: none"> • be able to solve and graph linear inequalities in one variable • be able to solve and graph polynomial inequalities in one variable • be able to graph polynomial inequalities in two variables <p>be able to graph the solution set of a system of inequalities</p>	<p>Create equations that describe numbers or relationships.</p> <ul style="list-style-type: none"> • A-CED.1. Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i> • A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and 	smartboard, computer, textbook, graphing calculator	Teacher generated quizzes and tests

		<p>scales.</p> <ul style="list-style-type: none">• A-CED.3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. <i>For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.</i> <p>Solve equations and inequalities in one variable.</p> <ul style="list-style-type: none">• A-REI.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. <p>Represent and solve equations and inequalities graphically.</p> <ul style="list-style-type: none">• A-REI.10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in		
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		<p>the coordinate plane, often forming a curve (which could be a line).</p> <ul style="list-style-type: none"> A-REI.11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. □ 		
<p>Unit 4</p> <p>Properties of Functions</p>	<p><i>Students will ...</i></p> <ul style="list-style-type: none"> be able to identify a function determine the domain, range and zeros of a function be able to graph a function 	<p>Understand the concept of a function and use function notation.</p> <ul style="list-style-type: none"> F-IF.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each 	<p>smartboard, computer, textbook, graphing calculator</p>	<p>Teacher generated quizzes and tests</p>

	<ul style="list-style-type: none"> • perform operations on a function and determine the domain of the resulting function • to reflect graphs and to use symmetry to sketch graphs • be able to determine periodicity and amplitude from graphs • be able to stretch and translate graphs <p>to find the inverse of a function, if an inverse exists</p>	<p>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 $y = f(x)$.</p> <ul style="list-style-type: none"> • F-IF.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.3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. <i>For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.</i> <p>Interpret functions that arise in applications in terms of the context.</p>		
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		<ul style="list-style-type: none">• F-IF.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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> □• F-IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>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.</i> □• F-IF.6. Calculate and		
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		<p>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. □</p> <p>Analyze functions using different representations.</p> <ul style="list-style-type: none">• F-IF.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. □<ul style="list-style-type: none">○ 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,		
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		<p>identifying zeros when suitable factorizations are available, and showing end behavior.</p> <ul style="list-style-type: none">○ 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. <ul style="list-style-type: none">● F-IF.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.<ul style="list-style-type: none">○ a. Use the process		
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		<p>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.</p> <ul style="list-style-type: none">○ 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. <ul style="list-style-type: none">● F-IF.9. Compare properties of two functions each represented in a different		
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		<p>way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</i></p>		
<p>Unit 5</p> <p>Exponents and Logarithms</p>	<p><i>Students will ...</i></p> <ul style="list-style-type: none"> • be able to define and apply integral exponents • be able to define and apply rational exponents • be able to define and use exponential functions • be able to define and apply the natural exponential function • be able to define and apply logarithms • be able to prove and apply laws of logarithms 	<p>Rewrite rational expressions.</p> <ul style="list-style-type: none"> • A-APR.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.7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, 	<p>smartboard, computer, textbook, graphing calculator</p>	<p>Teacher generated quizzes and tests</p>

	<p>be able to solve exponential equations and to change logarithms from one base to another</p>	<p>and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.</p> <p>Construct and compare linear, quadratic, and exponential models and solve problems.</p> <p><input type="checkbox"/> F-LE.2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).</p> <p><input type="checkbox"/> F-LE.3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.</p> <p><input type="checkbox"/> F-LE.4. For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.</p>		
Unit 6	<i>Students will ...</i>	<ul style="list-style-type: none"> • F-IF.4. For a function that models a relationship 	smartboard, computer, textbook,	Teacher generated quizzes and tests

<p>Analytic Geometry</p>	<ul style="list-style-type: none"> • be able to prove theorems from geometry by using coordinates • be able to find equations of circles • be able to find the coordinates of any points where circles and lines meet • be able to find the equations of ellipses and to graph them • be able to find the equations of hyperbolas and to graph them. <p>be able to find the equations of parabolas and to graph them.</p>	<p>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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> □</p> <ul style="list-style-type: none"> • F-IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>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.</i> □ • F-IF.6. Calculate and interpret the average rate of change of a function 	<p>graphing calculator</p>	
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		(presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. □		
Unit 7 Trigonometric Functions	<p><i>Students will ...</i></p> <ul style="list-style-type: none"> • be able to find the measure of an angle in either degrees or radians • be able to find co-terminal angles • be able to find the arc length and sector area of a circle • be able to solve simple trig equations using sine and cosine • be able to use reference angles and a variety of other tools to find sine and cosine functions • be able to sketch the sine and cosine functions • to find values of 	<p>Define trigonometric ratios and solve problems involving right triangles</p> <ul style="list-style-type: none"> * G-SRT.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. * G-SRT.7. Explain and use the relationship between the sine and cosine of complementary angles. * G-SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. <p>Extend the domain of trigonometric functions using the unit circle.</p> <ul style="list-style-type: none"> * F-TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. * F-TF.2. Explain how the unit 	smartboard, computer, textbook, graphing calculator	Teacher generated quizzes and tests

	<p>tangent, cotangent, secant and cosecant functions and to sketch the graphs</p> <ul style="list-style-type: none"> • be able to find values of the inverse trig. functions 	<p>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.</p> <p>* F-TF.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 x, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.</p> <p>* F-TF.4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.</p> <p>Model periodic phenomena with trigonometric functions.</p> <p>* F-TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. □</p> <p>* F-TF.6. (+) Understand that restricting a trigonometric function</p>		
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		<p>to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.</p> <p>* F-TF.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. □</p>		
Unit 9	<p><i>Students will ...</i></p> <ul style="list-style-type: none"> • Be able to use trigonometry to find unknown sides or angles of a right triangle. • Be able to find the area of a triangle given the lengths of two sides and the measure of the included angle. • Be able to use the law of sines to find unknown parts of a triangle. • Be able to use the law of cosines to find unknown parts of a triangle. 	<p>Define trigonometric ratios and solve problems involving right triangles</p> <p>* G-SRT.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.</p> <p>* G-SRT.7. Explain and use the relationship between the sine and cosine of complementary angles.</p> <p>* G-SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. □</p> <p>Apply trigonometry to general triangles</p> <p>* G-SRT.9. (+) Derive the</p>	smartboard, computer, textbook, graphing calculator	Teacher generated quizzes and tests

	<ul style="list-style-type: none">• Be able to use trigonometry to solve navigation and surveying problems.	<p>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.</p> <ul style="list-style-type: none">* G-SRT.10. (+) Prove the Laws of Sines and Cosines and use them to solve problems.* G-SRT.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).		
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