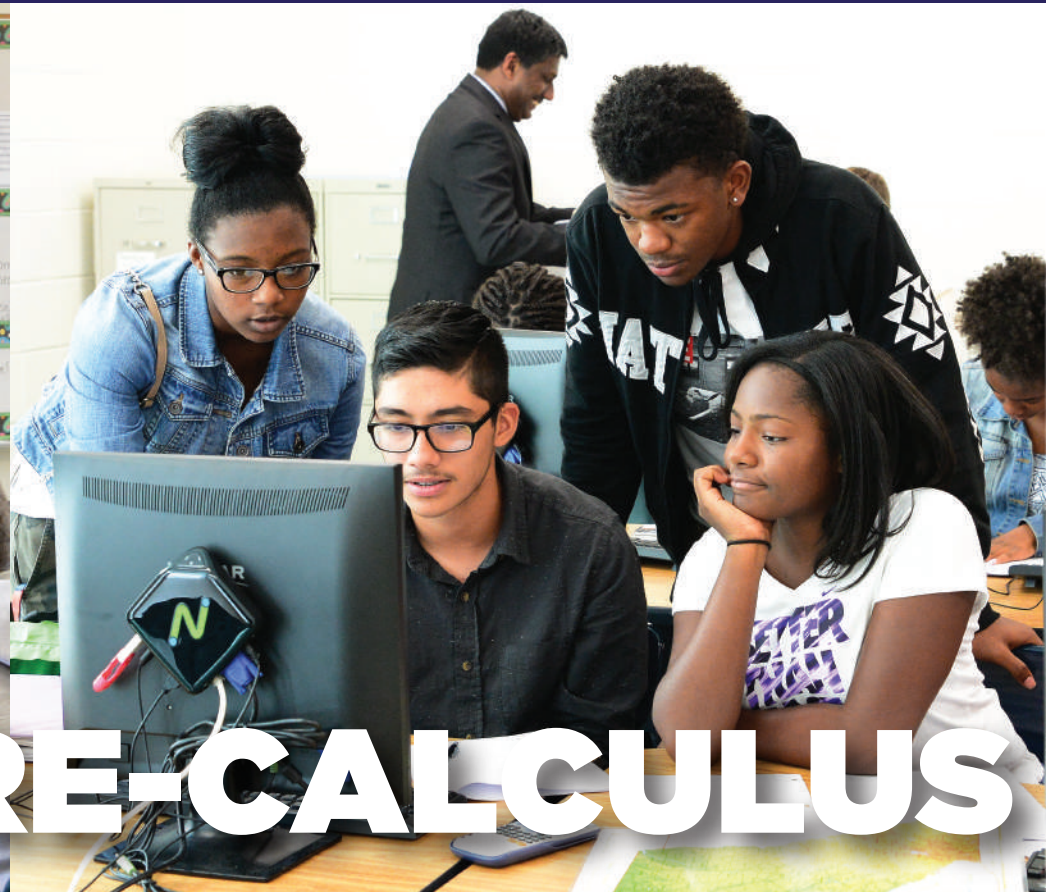




# HENRY COUNTY SCHOOLS

Better Together.



## PRE-CALCULUS

| MATH |

**HENRY**  
Teaching & Learning Standards





# Teaching & Learning Standards

**Math**

**Pre-Calculus**

## Pre-Calculus Math

Quarter 1		Quarter 2		Quarter 3		Quarter 4	
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
5 Weeks	4 Weeks	5 Weeks	4 Weeks	4 Weeks	5 Weeks	5 Weeks	4 Weeks
<b>Introduction to Trigonometric Functions</b>	<b>Trigonometric Functions</b>	<b>Trigonometry of General Triangles</b>	<b>Trigonometric Identities</b>	<b>Matrices</b>	<b>Conics</b>	<b>Vectors</b>	<b>Probability</b>
Interpret functions that arise in applications in terms of the context MGSE9-12.F.IF.4 (Multiple representations with characteristics & key features) Analyze functions using different representations MGSE9-12.F.IF.7 (Algebraic to graphs) MGSE9-12.F.IF.7e (Graph trig. functions) Extend the domain of trigonometric functions using the unit circle MGSE9-12.F.TF.1 (Radian measures) MGSE9-12.F.TF.2 (Unit circle)	Build new functions from existing functions MGSE9-12.F.BF.4 (Inverse functions) MGSE9-12.F.BF.4d (Invertible functions) Extend the domain of trigonometric functions using the unit circle MGSE9-12.F.TF.3 (Sine, cosine & tangent) MGSE9-12.F.TF.4 (Symmetry & periodicity) Model periodic phenomena with trigonometric functions MGSE9-12.F.TF.6 (Restricted domain) MGSE9-12.F.TF.7 (Inverse functions & modeling)	Apply trigonometry to general triangles MGSE9-12.G.SRT.9 (Derive the area of a triangle) MGSE9-12.G.SRT.10 (Prove Laws of Sines & Cosines) MGSE9-12.G.SRT.11 (Apply Laws of Sines & Cosines)	Prove and apply trigonometric identities MGSE9-12.F.TF.9 (Prove addition, subtraction, double and half-angle formulas) Extend the domain of trigonometric functions using the unit circle	Perform operations on matrices and use matrices in applications. MGSE9-12.N.VM.6 (Use matrices for data) MGSE9-12.N.VM.7 (Multiply matrices) MGSE9-12.N.VM.8 (Add, subtract & multiply matrices) MGSE9-12.N.VM.9 (Properties & multiplication of matrices) MGSE9-12.N.VM.10 (Zero & identity matrices)	Translate between the geometric description and the equation for a conic section MGSE9-12.G.GPE.2 (Derive the equation of a parabola) MGSE9-12.G.GPE.3 (Derive the equations of ellipses & hyperbolas) Solve systems of equations MGSE9-12.A.REI.7 (Solve a system of linear & quadratic equations)	Use properties of rational and irrational numbers. MGSE9-12.N.CN.3 (Conjugates of complex numbers) Represent complex numbers and their operations on the complex plane. MGSE9-12.N.CN.4 (Complex #'s on complex planes) MGSE9-12.N.CN.5 (Addition, subtraction, multiplication & conjugation of complex #'s geometrically) MGSE9-12.N.CN.6 (Distance in the complex plane) Represent and model with vector quantities. MGSE9-12.N.VM.1 (Magnitude & direction) MGSE9-12.N.VM.2	Use the rules of probability to compute probabilities of compound events in a uniform probability model MGSE9-12.S.CP.8 (General multiplication rule) MGSE9-12.S.CP.9 (Permutations & Combinations) Calculate expected values and use them to solve problems MGSE9-12.S.MD.1 (Graph probability distributions) MGSE9-12.S.MD.2 (Calculate the expected value) MGSE9-12.S.MD.3 (Develop a probability distribution-theoretical)

<p>Model periodic phenomena with trigonometric functions  MGSE9-12.F.TF.5  (Periodic phenomena)  Prove and apply trigonometric identities  MGSE9-12.F.TF.8  (Pythagorean identity)</p>				<p>MGSE9-12.N.VM.12  (2x2 matrices &amp; transformations)  Solve systems of equations  MGSE9-12.A.REI.8  (Systems &amp; matrices)  MGSE9-12.A.REI.9  (Inverse of a matrix)</p>		<p>(Components of a vector)  MGSE9-12.N.VM.3  (Velocity)  Perform operations on vectors.  MGSE9-12.N.VM.4  MGSE9-12.N.VM.4a  MGSE9-12.N.VM.4b  MGSE9-12.N.VM.4c  (Addition &amp; subtraction)  MGSE9-12.N.VM.5  MGSE9-12.N.VM.5a  MGSE9-12.N.VM.5a  MGSE9-12.N.VM.5b  (Scalar multiplication using vectors &amp; compute the magnitude)  Perform operations on matrices and use matrices in applications.  MGSE9-12.N.VM.11  (Multiply a vector by a matrix)</p>	<p>MGSE9-12.S.MD.4  (Develop a probability distribution-empirically-expected value)  Use probability to evaluate outcomes of decisions  MGSE9-12.S.MD.5  MGSE9-12.S.MD.5a  MGSE9-12.S.MD.5b  (Expected values &amp; expected payoff)  MGSE9-12.S.MD.6  (Fair decisions)  MGSE9-12.S.MD.7  (Probability concepts)</p>
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*Collaboration, Communication, Creativity, and Critical Thinking skills are embedded within the language of the Henry Teaching and Learning Standards*

HCS Graduate Learner Outcome

***As a Henry County graduate, I will be able to use mathematical practices to help make sense of the real world.***

GA Standard Code

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

HCS Graduate Learner Outcome

***As a Henry County graduate, I will be able to reason, describe, and analyze quantitatively using units and number systems to make sense of and solve problems.***

GA Standard Code

**MGSE9-12.N.CN** Use properties of rational and irrational numbers.

MGSE9-12.N.CN.3 Find the conjugate of a complex number; use the conjugate to find the absolute value (modulus) and quotient of complex numbers.

**MGSE9-12.N.CN** Represent complex numbers and their operations on the complex plane.

MGSE9-12.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.

MGSE9-12.N.CN.5 Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. *For example,  $(-1 + \sqrt{3}i)^3 = 8$  because  $(-1 + \sqrt{3}i)$  has modulus 2 and argument  $120^\circ$ .*

MGSE9-12.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.

**MGSE9-12.N.VM** Represent and model with vector quantities.

MGSE9-12.N.VM.1 Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g.,  $\mathbf{v}$ ,  $|\mathbf{v}|$ ,  $\|\mathbf{v}\|$ ,  $v$ ).

- MGSE9-12.N.VM.2 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
- MGSE9-12.N.VM.3 Solve problems involving velocity and other quantities that can be represented by vectors.

**MGSE9-12.N.VM Perform operations on vectors.**

- MGSE9-12.N.VM.4 Add and subtract vectors.
- MGSE9-12.N.VM.4a Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
- MGSE9-12.N.VM.4b Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
- MGSE9-12.N.VM.4c Understand vector subtraction  $\mathbf{v} - \mathbf{w}$  as  $\mathbf{v} + (-\mathbf{w})$ , where  $(-\mathbf{w})$  is the additive inverse of  $\mathbf{w}$ , with the same magnitude as  $\mathbf{w}$  and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.
- MGSE9-12.N.VM.5 Multiply a vector by a scalar.
- MGSE9-12.N.VM.5a Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as  $c(v_x, v_y) = (cv_x, cv_y)$ .
- MGSE9-12.N.VM.5b Compute the magnitude of a scalar multiple  $c\mathbf{v}$  using  $\|c\mathbf{v}\| = |c|\mathbf{v}$ . Compute the direction of  $c\mathbf{v}$  knowing that when  $|c| \neq 0$ , the direction of  $c\mathbf{v}$  is either along  $\mathbf{v}$  (for  $c > 0$ ) or against  $\mathbf{v}$  (for  $c < 0$ ).

**MGSE9-12.N.VM Perform operations on matrices and use matrices in applications.**

- MGSE9-12.N.VM.6 Use matrices to represent and manipulate data, e.g., transformations of vectors.
- MGSE9-12.N.VM.7 Multiply matrices by scalars to produce new matrices.
- MGSE9-12.N.VM.8 Add, subtract, and multiply matrices of appropriate dimensions.
- MGSE9-12.N.VM.9 Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
- MGSE9-12.N.VM.10 Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
- MGSE9-12.N.VM.11 Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.
- MGSE9-12.N.VM.12 Work with 2 X 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.



**MGSE9-12.A.REI Solve systems of equations.**

MGSE9-12.A.REI.8 Represent a system of linear equations as a single matrix equation in a vector variable.

MGSE9-12.A.REI.9 Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension  $3 \times 3$  or greater).

HCS Graduate Learner Outcome

***As a Henry County graduate, I will be able to create, interpret, use, and analyze patterns of algebraic structures to make sense of problems.***

GA Standard Code

**MGSE9-12.N.REI Solve systems of equations.**

MGSE9-12.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line  $y = -3x$  and the circle  $x^2 + y^2 = 3$ .*

HCS Graduate Learner Outcome

***As a Henry County graduate, I will be able to use functions to interpret and analyze a variety of contexts.***

GA Standard Code

**MGSE9-12.F.IF Interpret functions that arise in applications in terms of the context.**

MGSE9-12.F.IF.4 Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

**MGSE9-12.F.IF Analyze functions using different representations.**

MGSE9-12.F.IF.7 Graph functions expressed algebraically and show key features of the graph both by hand and by using technology.

MGSE9-12.F.IF.7e Graph trigonometric functions, showing period, midline, and amplitude.

**MGSE9-12.F.BF Build new functions from existing functions.**

MGSE9-12.F.BF.4 Find inverse functions

MGSE9-12.F.BF.4d Produce an invertible function from a non-invertible function by restricting the domain.

**MGSE9-12.F.TF Extend the domain of trigonometric functions using the unit circle.**

MGSE9-12.F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

MGSE9-12.F.TF.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.



## Mathematics

## HCS Teaching & Learning Standards

## Pre-Calculus

MGSE9-12.F.TF.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for  $\frac{\pi}{3}$ ,  $\frac{\pi}{4}$  and  $\frac{\pi}{6}$ , and use the unit circle to express the values of sine, cosine, and tangent for  $\pi - x$ ,  $\pi + x$ , and  $2\pi - x$  in terms of their values for  $x$ , where  $x$  is any real number.

MGSE9-12.F.TF.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

### MGSE9-12.F.TF Model periodic phenomena with trigonometric functions.

MGSE9-12.F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

MGSE9-12.F.TF.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.

MGSE9-12.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.

HCS Graduate Learner  
Outcome

*As a Henry County graduate, I will be able to prove, understand, and model geometric concepts using appropriate tools, theorems, and constructions to solve problems and apply logical reasoning.*

GA Standard Code

### MGSE9-12.F.TF Prove and apply trigonometric identities.

MGSE9-12.F.TF.8 Prove the Pythagorean identity  $(\sin A)^2 + (\cos A)^2 = 1$  and use it to find  $\sin A$ ,  $\cos A$ , or  $\tan A$ , given  $\sin A$ ,  $\cos A$ , or  $\tan A$ , and the quadrant of the angle.

MGSE9-12.F.TF.9 Prove addition, subtraction, double, and half-angle formulas for sine, cosine, and tangent and use them to solve problems.

### MGSE9-12.G.SRT Apply trigonometry to general triangles.

MGSE9-12.G.SRT.9 Derive the formula  $A = (\frac{1}{2})ab \sin(C)$  for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.

MGSE9-12.G.SRT.10 Prove the Laws of Sines and Cosines and use them to solve problems.

MGSE9-12.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).

### MGSE9-12.G.GPE Translate between the geometric description and the equation for a conic section.

MGSE9-12.G.GPE.2 Derive the equation of a parabola given a focus and directrix.

MGSE9-12.G.GPE.3 Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

## GA Standard Code

**MGSE9-12.S.CP****Use the rules of probability to compute probabilities of compound events in a uniform probability model.**

- MGSE9-12.S.CP.8 Apply the general Multiplication Rule in a uniform probability model,  $P(A \text{ and } B) = [P(A)] \times [P(B | A)] = [P(B)] \times [P(A | B)]$ , and interpret the answer in terms of the model.
- MGSE9-12.S.CP.9 Use permutations and combinations to compute probabilities of compound events and solve problems.

**MGSE9-12.S.MD****Calculate expected values and use them to solve problems.**

- MGSE9-12.S.MD.1 Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
- MGSE9-12.S.MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
- MGSE9-12.S.MD.3 Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*
- MGSE9-12.S.MD.4 Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*

**MGSE9-12.S.MD****Use probability to evaluate outcomes of decisions.**

- MGSE9-12.S.MD.5 Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
- MGSE9-12.S.MD.5a Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*
- MGSE9-12.S.MD.5b Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*
- MGSE9-12.S.MD.6 Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- MGSE9-12.S.MD.7 Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).