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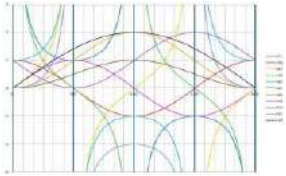
HENRY COUNTY SCHOOLS

Accelerated CCGPS Math III - Pre-Calculus
MATHEMATICS - Curriculum Map

(adapted from Georgia Department of Education)



Common Core Georgia Performance Standards							
SEMESTER 1				SEMESTER 2			
Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**	**Unit 6**	**Unit 7**	**Unit 8**
4 weeks	**3-6 weeks***	**3 weeks**	**2-3 weeks***	**4 weeks**	**5 weeks**	**4 weeks**	**4 weeks***
Conics	**Trigonometric Functions**	**Trigonometry of General Triangles**	**Trigonometric Identities**	**Matrices**	**Vectors**	**Probability**	**Introduction to Calculus**
G.GPE.3(+)	F.BF.4d(+) F.TF.3(+) F.TF.4(+) F.TF.6(+) F.TF.7(+)	G.SRT.9(+) G.SRT.10(+) G.SRT.11(+)	F.TF.9(+)	N.VM.6(+) N.VM.7(+) N.VM.8(+) N.VM.9(+) N.VM.10(+) N.VM.12(+) A.REI.8(+) A.REI.9(+)	N.CN.3(+) N.CN.4(+) N.CN.5(+) N.CN.6(+) N.VM.1(+) N.VM.2(+) N.VM.3(+) N.VM4a(+), b(+), c(+) N.VM.5a(+), b(+) N.VM.11(+)	S.CP.8(+) S.CP.9(+) S.MD.1(+) S.MD.2(+) S.MD.3(+) S.MD.4(+) S.MD.5a(+), b(+) S.MD.6(+) S.MD.7(+)	** Time Permitting*
"How can one build upon understanding of circles and parabolas to develop and explain other conic sections, including ellipses and hyperbolas?"	** Depends on Prerequisite Skills*		** Depends on Prerequisite Skills*				*"How can we use existing knowledge of Algebra (study of operations and their application to solving) and Geometry (study of shapes) to prepare for Calculus (mathematical study of change)?*
	"How can one evaluate, graph and apply trigonometric functions and their inverses?"	*"How can one apply trigonometry to solve real life problems involving general triangles?"*	*"How can trigonometric identities be used to simplify trigonometric expressions?"*	*"How can one apply and perform operations with matrices to solve systems of equations?"*	*"How can one model and perform operations with vectors and complex numbers?"*	*How can one make and evaluate predictions using theoretical probabilities of compound events?*	

Grade 9-12 Key:

Number and Quantity Strand: RN = The Real Number System, Q = Quantities, CN = Complex Number System, VM = Vector and Matrix Quantities

Algebra Strand: SSE = Seeing Structure in Expressions, APR = Arithmetic with Polynomial and Rational Expressions, CED = Creating Equations, REI = Reasoning with Equations and Inequalities

Functions Strand: IF = Interpreting Functions, LE = Linear and Exponential Models, BF = Building Functions, TF = Trigonometric Functions

Geometry Strand: CO = Congruence, SRT = Similarity, Right Triangles, and Trigonometry, C = Circles, GPE = Expressing Geometric Properties with Equations, GMD = Geometric Measurement and Dimension, MG = Modeling with Geometry

Statistics and Probability Strand: ID = Interpreting Categorical and Quantitative Data, IC = Making Inferences and Justifying Conclusions, CP = Conditional Probability and the Rules of Probability, MD = Using Probability to Make Decisions

Specific modeling standards appear throughout the high school standards indicated by a star symbol (★).

CCGPS Accelerated Pre-Calculus - 1st Semester

Standards for Mathematical Practice *(addressed within learning tasks throughout the year)*	
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.

Common Core Georgia Performance Standards: Curriculum Map

Unit 1	Unit 2	Unit 3	Unit 4
Conics	**Trigonometric Functions**	**Trigonometry of General Triangles**	**Trigonometric Identities**
Translate between the geometric description and the equation for a conic section **MCC9-12.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.	**Build new functions from existing functions** **MCC9-12.F.BF.4** Find inverse functions. **MCC9-12.F.BF.4d (+)** Produce an invertible function from a non-invertible function by restricting the domain. **Extend the domain of trigonometric functions using the unit circle** **MCC9-12.F.TF.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. **MCC9-12.F.TF.4 (+)** Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. **Model periodic phenomena with trigonometric functions** **MCC9-12.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. **MCC9-12.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.★	**Apply trigonometry to general triangles** **MCC9-12.G.SRT.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. **MCC9-12.G.SRT.10 (+)** Prove the Laws of Sines and Cosines and use them to solve problems. **MCC9-12.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).	**Prove and apply trigonometric identities** **MCC9-12.F.TF.9 (+)** Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems

CCGPS Accelerated Pre-Calculus – 2nd Semester

Standards for Mathematical Practice

(addressed within learning tasks throughout the year)

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.

Common Core Georgia Performance Standards: Curriculum Map

Unit 5

Matrices

Perform operations on matrices and use matrices in applications.

MCC9-12.N.VM.6 (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

MCC9-12.N.VM.7 (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.

MCC9-12.N.VM.8 (+) Add, subtract, and multiply matrices of appropriate dimensions.

MCC9-12.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.

MCC9-12.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.

MCC9-12.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.

Solve systems of equations

MCC9-12.A.REI.8 (+) Represent a system of linear equations as a single matrix equation in a vector variable.

MCC9-12.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 × 3 or greater).

Unit 6

Vectors

Perform arithmetic operations with complex numbers.

MCC9-12.N.CN.3 (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

Represent complex numbers and their operations on the complex plane.

MCC9-12.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.

MCC9-12.N.CN.5 (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.

MCC9-12.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.

Represent and model with vector quantities.

MCC9-12.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., **v**, $|\mathbf{v}|$, $||\mathbf{v}||$, *v*).

MCC9-12.N.VM.2 (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

MCC9-12.N.VM.3 (+) Solve problems involving velocity and other quantities that can be represented by vectors.

Perform operations on vectors.

MCC9-12.N.VM.4 (+) Add and subtract vectors.

MCC9-12.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.

MCC9-12.N.VM.4b (+) Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

MCC9-12.N.VM.4c Understand vector subtraction $\mathbf{v} - \mathbf{w}$ as $\mathbf{v} + (-\mathbf{w})$, where $(-\mathbf{w})$ is the additive inverse of **w**, with the same magnitude as **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.

MCC9-12.N.VM.5 (+) Multiply a vector by a scalar.

MCC9-12.N.VM.5a (+) Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(\mathbf{v}_x, \mathbf{v}_y) = (c\cdot\mathbf{v}_x, c\cdot\mathbf{v}_y)$.

MCC9-12.N.VM.5b (+) Compute the magnitude of a scalar multiple c**v** using $||c\mathbf{v}|| = |c|\mathbf{v}$. Compute the direction of c**v** knowing that when $|c|\mathbf{v} \neq 0$, the direction of c**v** is either along **v** (for $c > 0$) or against **v** (for $c < 0$).

Perform operations on matrices and use matrices in applications.

MCC9-12.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.

Unit 7

Probability

Use the rules of probability to compute probabilities of compound events in a uniform probability model

MCC9-12.S.CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = [P(A)]x[P(B|A)] =[P(B)]x[P(A|B)], and interpret the answer in terms of the model.★

MCC9-12.S.CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.★

Calculate expected values and use them to solve problems

MCC9-12.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.★

MCC9-12.S.MD.2 (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.★

MCC9-12.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.★

MCC9-12.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.★

Use probability to evaluate outcomes of decisions

MCC9-12.S.MD.5 (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.★

MCC9-12.S.MD.5a (+) Find the expected payoff for a game of chance.★

MCC9-12.S.MD.5b (+) Evaluate and compare strategies on the basis of expected values.★

MCC9-12.S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).★

MCC9-12.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).★

Unit 8: Introduction to Calculus

See Unit Plan for helpful resources addressing concepts.

Accelerated CCGPS Pre-Calculus: Unit Descriptions

Pre-Calculus focuses on standards to prepare students for a more intense study of mathematics. The critical areas organized in seven units delve deeper into content from previous courses. The study of circles and parabolas is extended to include other conics such as ellipses and hyperbolas. Trigonometric functions are further developed to include inverses, general triangles and identities. Matrices provide an organizational structure in which to represent and solve complex problems. Students expand the concepts of complex numbers and the coordinate plane to represent and operate upon vectors. Probability rounds out the course using counting methods, including their use in making and evaluating decisions. The Mathematical Practice Standards apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations.

Unit 1: This unit builds upon the understanding of the algebraic representations of circles and parabolas. Students develop the understanding of the geometric description and the equation for the conic sections, ellipses and hyperbolas.

Unit 2: Trigonometric functions and the unit circle are further investigated. Students create inverses of trigonometric functions by restricting the domain.

Unit 3: In this unit students expand the use of trigonometric functions beyond right triangles into more general triangles. The students develop the trigonometric formula for area of triangle and use the Laws of Sines and Cosines to solve problems.

Unit 4: Students build upon their work with trigonometric identities with addition and subtraction formulas and use them to solve problems.

Unit 5: In this unit, students learn to compute with matrices. They use matrices in order to represent and solve more complex problems such as systems.

Unit 6: In this unit, students further their understanding of complex numbers through graphical representations. Vector operations are used to represent and model various quantities such as velocity.

Unit 7: Students expand their ability to compute and interpret theoretical and experimental probabilities for compound events, attending to mutually exclusive events, independent events, and conditional probability. Students should make use of geometric probability models wherever possible. They use probability to make informed decisions.

Unit 8: *NOTE: Henry County Schools added this unit to the GaDOE Curriculum to ensure students are prepared for AP Calculus next year.* In this unit, students revisit key algebraic and trigonometric skills which are vital to their subsequent AP Calculus course next year.

Summary of Standards for Mathematical Practice	Questions to Develop Mathematical Thinking
1. Make sense of problems and persevere in solving them. Interpret and make meaning of the problem looking for starting points. Analyze what is given to explain to themselves the meaning of the problem. Plan a solution pathway instead of jumping to a solution. Can monitor their progress and change the approach if necessary. See relationships between various representations. Relate current situations to concepts or skills previously learned and connect mathematical ideas to one another. Can understand various approaches to solutions. Continually ask themselves; "Does this make sense?"	How would you describe the problem in your own words? How would you describe what you are trying to find? What do you notice about...? What information is given in the problem? Describe the relationship between the quantities. Describe what you have already tried. What might you change? Talk me through the steps you've used to this point. What steps in the process are you most confident about? What are some other strategies you might try? What are some other problems that are similar to this one? How might you use one of your previous problems to help you begin? How else might you organize...represent... show...?
2. Reason abstractly and quantitatively. Make sense of quantities and their relationships. Are able to decontextualize (represent a situation symbolically and manipulate the symbols) and contextualize (make meaning of the symbols in a problem) quantitative relationships. Understand the meaning of quantities and are flexible in the use of operations and their properties. Create a logical representation of the problem. Attends to the meaning of quantities, not just how to compute them.	What do the numbers used in the problem represent? What is the relationship of the quantities? How is related to ? What is the relationship between and ? What does mean to you? (e.g. symbol, quantity, diagram) What properties might we use to find a solution? How did you decide in this task that you needed to use...? Could we have used another operation or property to solve this task? Why or why not?
3. Construct viable arguments and critique the reasoning of others. Analyze problems and use stated mathematical assumptions, definitions, and established results in constructing arguments. Justify conclusions with mathematical ideas. Listen to the arguments of others and ask useful questions to determine if an argument makes sense. Ask clarifying questions or suggest ideas to improve/revise the argument. Compare two arguments and determine correct or flawed logic.	What mathematical evidence would support your solution? How can we be sure that...? / How could you prove that...? Will it still work if...? What were you considering when...? How did you decide to try that strategy? How did you test whether your approach worked? How did you decide what the problem was asking you to find? (What was unknown?) Did you try a method that did not work? Why didn't it work? Would it ever work? Why or why not? What is the same and what is different about...? How could you demonstrate a counter-example?
4. Model with mathematics. Understand this is a way to reason quantitatively and abstractly (able to decontextualize and contextualize). Apply the math they know to solve problems in everyday life. Are able to simplify a complex problem and identify important quantities to look at relationships. Represent mathematics to describe a situation either with an equation or a diagram and interpret the results of a mathematical situation. Reflect on whether the results make sense, possibly improving or revising the model. Ask themselves, "How can I represent this mathematically?"	What number model could you construct to represent the problem? What are some ways to represent the quantities? What's an equation or expression that matches the diagram..., number line.., chart..., table..? Where did you see one of the quantities in the task in your equation or expression? Would it help to create a diagram, graph, table...? What are some ways to visually represent...? What formula might apply in this situation?

Summary of Standards for Mathematical Practice	Questions to Develop Mathematical Thinking
5. Use appropriate tools strategically. **Use available tools recognizing the strengths and limitations of each.** **Use estimation and other mathematical knowledge to detect possible errors.** **Identify relevant external mathematical resources to pose and solve problems.** **Use technological tools to deepen their understanding of mathematics.**	What mathematical tools could we use to visualize and represent the situation? What information do you have? What do you know that is not stated in the problem? What approach are you considering trying first? What estimate did you make for the solution? In this situation would it be helpful to use...a graph..., number line..., ruler..., diagram..., calculator..., manipulative? Why was it helpful to use...? What can using a show us, that _may not? In what situations might it be more informative or helpful to use...?
6. Attend to precision. **Communicate precisely with others and try to use clear mathematical language when discussing their reasoning.** **Understand meanings of symbols used in mathematics and can label quantities appropriately.** **Express numerical answers with a degree of precision appropriate for the problem context.** **Calculate efficiently and accurately.**	What mathematical terms apply in this situation? How did you know your solution was reasonable? Explain how you might show that your solution answers the problem. Is there a more efficient strategy? How are you showing the meaning of the quantities? What symbols or mathematical notations are important in this problem? What mathematical language..., definitions..., properties can you use to explain...? How could you test your solution to see if it answers the problem?
7. Look for and make use of structure. **Apply general mathematical rules to specific situations.** **Look for the overall structure and patterns in mathematics.** **See complicated things as single objects or as being composed of several objects.**	What observations do you make about...? What do you notice when...? What parts of the problem might you eliminate..., simplify...? What patterns do you find in...? How do you know if something is a pattern? What ideas that we have learned before were useful in solving this problem? What are some other problems that are similar to this one? How does this relate to...? In what ways does this problem connect to other mathematical concepts?
8. Look for and express regularity in repeated reasoning. **See repeated calculations and look for generalizations and shortcuts.** **See the overall process of the problem and still attend to the details.** **Understand the broader application of patterns and see the structure in similar situations.** **Continually evaluate the reasonableness of their intermediate results.**	Will the same strategy work in other situations? Is this always true, sometimes true or never true? How would we prove that...? What do you notice about...? What is happening in this situation? What would happen if...? Is there a mathematical rule for...? What predictions or generalizations can this pattern support? What mathematical consistencies do you notice?