-------------------LCPS Precalculus Yearly Overview and Scope and Sequence 2021-22

Precalculus Yearly Overview 2021-22

Quarter 1	**Functions** Standards of Learning: MA.1, MA.3, MA.4, MA.5	**Exponential and Logarithmic Functions** Standards of Learning: MA.2, MA.4

Quarter 2	**Trigonometric Functions** Standards of Learning: T.1, T.2, T.3, T.4, T.7, T.9a	

Quarter 3	**Analytical Trigonometry** Standards of Learning: T.5, T.6	**Geometric Applications** Standards of Learning: T.8, T.9b

Quarter 4	**Matrices and Conics** Standards of Learning: MA.6, MA.11	**Sequences and Series** Standards of Learning: MA.12, MA.13, MA.14

VDOE Process Goals
- To build new mathematical knowledge through problem solving and to develop a repertoire of skills and strategies for solving a variety of problem types **(Problem Solving)**
- To communicate mathematical ideas coherently and clearly and to analyze and evaluate the mathematical thinking of others **(Communication)**
- To use logical reasoning in solving mathematical problems and to explain and justify mathematical ideas **(Reasoning)**
- To understand how mathematical ideas interconnect and build on one another and to use those connections to solve problems **(Connections)**
- To create and use a variety of representations in learning, doing, and communicating mathematics **(Representations)**

Precalculus Scope and Sequence

The Loudoun County Public Schools Mathematics Scope and Sequence provides a broad overview of the content units, the quarter in which each unit is taught, and the sequence of the standards within each unit. Resources to support instruction are located in the [Mathematics Curriculum Schoology Groups](#).

[Curriculum Framework](#)**:** The Curriculum Framework contains the 2016 *Mathematics Standards of Learning*, guidance for Understanding the Standard, and Essential Knowledge and Skills for students. Students are expected to continue to connect and apply knowledge and skills from Standards of Learning presented in previous grades as they deepen their mathematical understanding. Assessment items may not and should not be a verbatim reflection of the information presented in the Curriculum Framework.

Prerequisite Knowledge: These standards are the supporting concepts for the grade level concept. The hyperlinks are to the Just In Time Quick Check documentation which includes teacher notes, instructional plans, formative assessments, and activities to support student learning.

[Just In Time Quick Checks](#): Just in Time Mathematics Quick Checks are formative assessments that align to the 2016 Mathematics Standards of Learning (SOL). They are designed to help teachers identify students with unfinished learning and assist in planning instruction to fill potential gaps "just in time." As new content is introduced throughout the school year, teachers can use these Quick Checks to identify and diagnose unfinished learning at grade level and/or to assess understanding of prerequisite knowledge that may be needed to access grade level content. Student gaps in mathematics understanding exist for a variety of reasons and these resources can be used to help get student mathematical learning back on track.

Essential Skills and Knowledge: This section provides a detailed expansion of the mathematics knowledge and skills that each student should know and be able to demonstrate. This is not meant to be an exhaustive list of student expectations.

Quarter 1

Functions

Curriculum Framework: MA.1, MA.3, MA.4, MA.5

Prerequisite Knowledge	Essential Skills and Knowledge (with links to VDOE Just In Time Quick Checks for details on how to support student understanding for each standard)

AII.1b, AII.1c, AII.2, AII.3c AII.6a, AII.7a, AII.7b, AII.7c, AII.7d, AII.7e, AII.7f, AII.7g, AII.7h, AII.7i, AII.8	**MA. 1 Investigate and identify the properties of polynomial, rational, piecewise, and step functions and sketch the graphs of the functions.**
	● Identify a polynomial, rational, piecewise, and step function, given an equation or graph.
	● Given a graph or equation of a polynomial, rational, piecewise, or step function, identify:
	  o domain and range;
	  o zeros;
	  o intercepts;
	  o symmetry;
	  o asymptotes (horizontal, vertical, and oblique/slant);
	  o points of discontinuity;
	  o intervals for which the function is increasing, decreasing or constant;
	  o end behavior; and
	  o relative and/or absolute maximum and minimum points.
	● Sketch the graph of a polynomial, rational, piecewise, or step function.
	● Investigate and verify characteristics of a polynomial, rational, piecewise, and step function, using a graphing utility.
	● Rationalize the denominator of a rational function.

AII.7j, AII.7k	**MA.3 Apply compositions of functions and inverses of functions to practical situations and investigate and verify the domain and range of resulting functions.** ● Determine the composition of functions algebraically and graphically. ● Determine the inverse of a function algebraically and graphically.

	● Determine the domain and range of composite functions algebraically and graphically. ● Determine the domain and range of the inverse of a function algebraically and graphically.
AII.7i	**MA.5 Investigate and describe the continuity of functions.** ● Describe continuity of a function. ● Investigate the continuity of functions including absolute value, step, rational, and piecewise functions, using graphical and algebraic methods. ● Classify types of discontinuity. ● Prove continuity at a point, using the definition of limits.
AII.7h	**MA.4 Determine the limit of an algebraic function, if it exists, as the variable approaches either a finite number or infinity.** ● Verify estimates about the limit of a function using a graphing utility. ● Determine the limit of a function algebraically and verify with a graphing utility. ● Determine the limit of a function numerically and verify with a graphing utility. ● Use limit notation when describing end behavior of a function.

Exponential and Logarithmic Functions

Curriculum Framework: MA.2, MA.4

Prerequisite Knowledge	**Essential Skills and Knowledge** (with links to VDOE Just In Time Quick Checks for details on how to support student understanding for each standard)
AII.1b, AII.6a, AII.7a, AII.7b, AII.7c, AII.7d, AII.7e, AII.7f, AII.7g, AII.7h, AII.7i	**MA.2 Investigate and identify the characteristics of exponential and logarithmic functions to graph the function, solve equations, and solve practical problems.** ● Identify exponential functions from an equation or a graph. ● Identify logarithmic functions from an equation or a graph. ● Define e, and know its approximate value. ● Convert between equations written in logarithmic and exponential form. ● Identify common and natural logarithms, given an equation or practical situation.

	- Use laws of exponents and logarithms to solve equations and simplify expressions. - Model practical problems, using exponential and logarithmic functions. - Graph exponential and logarithmic functions and identify asymptotes, end behavior, intercepts, domain, and range.
AII.7h	**MA.4 Determine the limit of an algebraic function, if it exists, as the variable approaches either a finite number or infinity.** - Verify estimates about the limit of a function using a graphing utility. - Determine the limit of a function algebraically and verify with a graphing utility. - Determine the limit of a function numerically and verify with a graphing utility. - Use limit notation when describing end behavior of a function.

Quarter 2

Trigonometric Functions

Curriculum Framework: T.1, T.2, T.3, T.4, T.7, T.9a

Prerequisite Knowledge MVAT	Essential Skills and Knowledge (with links to VDOE Just In Time Quick Checks for details on how to support student understanding for each standard)
G.11c, G.11d	**T.9a Solve problems, including practical problems, involving arc length and area of sectors in circles using radians and degrees** ● Convert between any angle expressed in radians and degrees without using a graphing utility. ● Derive the relationship between the radian measure of an angle and the length of the intercepted arc. ● Calculate the length of an arc in radians. ● Calculate the area of sectors in circles.
G.8a, G.8b, G.8c	**T.2 The student will develop and apply the properties of the unit circle in degrees and radians.** ● Define the six circular trigonometric functions of an angle in standard position. ● Apply the properties of the unit circle to determine trigonometric function values of special angles and their related angles in both degrees and radians without using a graphing utility. ● Apply the properties of the unit circle to convert between special angles expressed in radians and degrees, without using a graphing utility.
	T.1 The student, given a point on the terminal side of an angle in standard position, or the value of the trigonometric function of the angle, will determine the sine, cosine, tangent, cotangent, secant, and cosecant of the angle. ● Define the six triangular trigonometric functions of an angle in a right triangle. ● Draw a reference right triangle when given a point on the terminal side of the angle in standard position. ● Draw a reference right triangle when given the value of a trigonometric function of the angle.

Loudoun County Public Schools

	● Determine the value of any trigonometric function when given a point on the terminal side of an angle in standard position. ● Given one trigonometric function value, determine the other five trigonometric function values.
	T.3d Investigate the effect of changing the parameters in a trigonometric function on the graph of the function ● Describe the effect of changing A, B, C, or D in the standard form of a trigonometric equation.
	T.3a State the domain and the range of the function ● State the domain and the range of a trigonometric function written in standard form.
	T.3b Determine the amplitude, period, phase shift, vertical shift, and asymptote ● Determine the amplitude, period, phase shift, vertical shift, and asymptotes of a trigonometric function from the equation of the function and from the graph of the function.
	T.3c Sketch the graph of the function by using transformations for at least a two-period interval ● Sketch the graph of a function written in standard form by using transformations for at least a two-period interval, including both positive and negative values for the domain.
	T.4 Graph the six inverse trigonometric functions ● Determine the domain and range of the inverse trigonometric functions. ● Use the restrictions on the domains of the inverse trigonometric functions in determining the values of the inverse trigonometric functions. ● Graph inverse trigonometric functions.
G.8a, G.8b, G.8c	**T.7 Determine the value of any trigonometric function and inverse trigonometric function** ● Use a graphing utility to determine the trigonometric function values of any angle in either degrees or radians. ● Define inverse trigonometric functions. ● Determine angle measures by using the inverse trigonometric functions when the trigonometric function values are given.

Quarter 3

Analytical Trigonometry

Curriculum Framework: T.5, T.6

Prerequisite Knowledge	Essential Skills and Knowledge
	T.6 The student will solve trigonometric equations and inequalities. ● Solve trigonometric equations with and without restricted domains algebraically and graphically. ● Solve trigonometric inequalities algebraically and graphically. ● Verify algebraic solutions, using a graphing utility.
	T.5 Verify basic trigonometric identities and make substitutions, using the basic identities. ● Use trigonometric identities to make algebraic substitutions to simplify and verify trigonometric identities. The basic trigonometric identities include 　○ reciprocal identities; 　○ Pythagorean identities; 　○ sum and difference identities; 　○ double-angle identities; and 　○ half-angle identities.

Geometric Applications

Prerequisite Knowledge	Essential Skills and Knowledge
G.8a, G.8b, G.8c	**T.8 The student will create and solve practical problems involving triangles.** ● Create and solve practical problems involving triangles. ● Use the trigonometric functions, Pythagorean Theorem, Law of Sines, and Law of Cosines to solve practical problems. ● Use the trigonometric functions to model practical situations. ● Identify a solution technique associated with triangles that could be used with a given problem. ● Apply the sum and difference identities for sine, cosine, and tangent to solve problems.
	T.9b Solve problems, including practical problems, involving linear and angular velocity. ● Solve practical problems involving linear and angular velocity.

Quarter 4

Matrices and Conics

Curriculum Framework: MA.6, MA.11

Prerequisite Knowledge	Essential Skills and Knowledge
A.4d, AII.4	**MA.11 Use matrices to organize data and will add and subtract matrices, multiply matrices, multiply matrices by a scalar, and use matrices to solve systems of equations.** ● Multiply matrices by a scalar. ● Add, subtract, and multiply matrices. ● Model problems with a system of no more than three linear equations. ● Express a system of linear equations as a matrix equation. ● Solve a system of equations using matrices. ● Determine the inverse of a two-by-two or three-by-three matrix using paper and pencil. ● Verify two matrices are inverses using matrix multiplication. ● Verify the commutative and associative properties for matrix addition and multiplication.
G.3d, G.12, AII.6b	**MA.6 Investigate, graph, and identify the properties of conic sections from equations in vertex and standard form.** ● Given a translation or rotation matrix, determine an equation for the transformed function or conic section. ● Investigate and verify graphs of transformed conic sections, using a graphing utility. ● Graph conic sections from equations written in vertex or standard form using transformations. ● Identify properties of conic sections.

Sequences and Series

[Curriculum Framework](...): MA.12, MA.13, MA.14

Prerequisite Knowledge	Essential Skills and Knowledge
	MA.14 Use mathematical induction to prove formulas and mathematical statements. ● Compare inductive and deductive reasoning. ● Prove formulas and mathematical statements, using mathematical induction.
	MA.12 Expand binomials having positive integral exponents. ● Expand binomials having positive integral exponents. ● Use the Binomial Theorem, the formula for combinations, and Pascal's Triangle to expand binomials.
	MA.13 Determine the sum of finite and infinite convergent series. ● Use and interpret the notation: $\sum$, n, nth, and a_n. ● Derive the formulas associated with arithmetic and geometric sequences and series. ● Given the formula, determine the nth term, a_n, for an arithmetic or geometric sequence. ● Given the formula, determine the sum, S_n, if it exists, of an arithmetic or geometric series. ● Model and solve problems, using sequence and series information. ● Distinguish between a convergent and divergent series. ● Discuss convergent series in relation to the concept of a limit.