LCPS AFM Yearly Overview and Scope and Sequence 2021-22

Advanced Functions and Modeling Yearly Overview 2021-22

Quarter 1	Linear Functions AFM.1, AFM.4	Quadratic Functions AFM.2, AFM.4	Polynomial Functions AFM.3, AFM.4

Quarter 2	Exponential and Logarithmic Functions AFM.4, AFM.5	Rational and Radical Functions AFM.4, AFM.6

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Quarter 4	Analytical Trigonometry AFM.11, AFM.12	Applications of Trigonometry AFM.13

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)**

Advanced Functions and Modeling 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](.).

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.

Objective: 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

Linear Functions and Function Families
Standards: AFM.1, AFM.4

Prerequisite Knowledge	Objectives
G.3b, AII.7a, AII.7b, AII.7c, AII.7d, AII.7e, AII.7f, AII.7g, AII.7h, AII.7i, AII.7k, AII.9	**AFM.1 Identify, graph, and write linear functions and to apply the concepts of linear functions to real world models.** ● Recognize the solution of a linear equation is the zero of the function. ● Fit linear functions to data by using algebra and technology. ● Summarize and analyze results in application problems using reasoning/ problem solving techniques (i.e., What does the y-intercept represent in this problem? Explain how the answer does/ does not make sense in a real world situation? What other factors may influence your results when applied to a similar situation?) ● Recognize the special properties of parallel and perpendicular lines. ● Graph piecewise linear functions. ● Graph absolute value equations in two variables and recognize them as piecewise linear functions. ● Find domain, range, end behavior, symmetry of linear functions.
	AFM.4 Find the domain, range, zeros, and inverse of a function, the value of a function for a given element in its domain, and the composition of multiple functions. ● Identify the domain, range, zeros, and inverse of a function presented algebraically or graphically. ● Distinguish between relations and functions that are expressed algebraically and graphically. ● Recognize restricted/discontinuous domains and ranges. ● Use interchange of variables to find the inverse of a function. ● Find the composition of two functions. ● Use graphing technology to investigate functions and to solve real world problems.

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Quadratic Functions

Standards: AFM.2

Prerequisite Knowledge	Objectives
G.3b, AII.7a, AII.7b, AII.7c, AII.7d, AII.7e, AII.7f, AII.7g, AII.7h, AII.7i, AII.7k, AII.9	**AFM.4 Identify, graph, and write quadratic functions and to apply the concepts of quadratic functions to real world models.** ● Graph quadratic equations by using the vertex and axis of symmetry, vertex/standard form, and transformations. ● Select an appropriate strategy for solving a quadratic equation (factoring, completing the square, using the quadratic formula, or graphing). ● Recognize the solution(s) of a quadratic equation is/are the zero(s) of the function. ● Fit quadratic functions to data by using algebra and technology. ● Solve a quadratic equation over the set of complex numbers. ● Find domain, range, end behavior, symmetry of quadratic functions.
	AFM.4 Find the domain, range, zeros, and inverse of a function, the value of a function for a given element in its domain, and the composition of multiple functions. ● Identify the domain, range, zeros, and inverse of a function presented algebraically or graphically. ● Distinguish between relations and functions that are expressed algebraically and graphically. ● Recognize restricted/discontinuous domains and ranges. ● Use interchange of variables to find the inverse of a function. ● Find the composition of two functions. ● Use graphing technology to investigate functions and to solve real world problems.

Polynomial Functions

Standards: AFM.3

Prerequisite Knowledge	Objectives
AII.1c, AII.7a, AII.7b, AII.7c, AII.7d, AII.7e, AII.7f, AII.7g, AII.7h, AII.7i, AII.7k, AII.8	**AFM.3 Identify, graph, and write polynomial functions and to apply the concepts of polynomial functions to real world models.** ● Recognize general shapes and end behavior of polynomial functions. ● Graph polynomial functions by including relative extrema. ● Recognize the solution(s) of a polynomial equation is/are the zero(s) of the function. ● Fit polynomial functions to data by using algebra and technology. ● Solve a polynomial equation over the set of complex numbers. Find the number of real versus the number of imaginary roots and describe how that affects the nature of the graph. Include Descartes' Rule of Signs. ● Write a polynomial function given zero(s). ● Find domain, range, end behavior, symmetry of polynomial functions.
	AFM.4 Find the domain, range, zeros, and inverse of a function, the value of a function for a given element in its domain, and the composition of multiple functions. ● Identify the domain, range, zeros, and inverse of a function presented algebraically or graphically. ● Distinguish between relations and functions that are expressed algebraically and graphically. ● Recognize restricted/discontinuous domains and ranges. ● Use interchange of variables to find the inverse of a function. ● Find the composition of two functions. ● Use graphing technology to investigate functions and to solve real world problems.

Quarter 2

Exponential and Logarithmic Functions
Standards: AFM.5

Prerequisite Knowledge	Objectives
AII.7a, AII.7b, AII.7c, AII.7d, AII.7e, AII.7f, AII.7g, AII.7h, AII.7i AII.7k, AII.9	**AFM.5 Identify, graph, and write exponential and logarithmic functions and to apply the concepts of exponential and logarithmic functions to real world models.** ● Recognize general shapes of exponential and logarithmic functions. This should include common and natural logarithms. Find domain, range, and end behavior. ● Graphically and algebraically recognize that exponential and logarithmic functions are inverses of each other. ● Fit exponential and logarithmic functions to data by using algebra and technology. ● Solve exponential and logarithmic equations by applying properties of exponents and logarithms. ● If time, investigate logistic growth models.
	AFM.4 Find the domain, range, zeros, and inverse of a function, the value of a function for a given element in its domain, and the composition of multiple functions. ● Identify the domain, range, zeros, and inverse of a function presented algebraically or graphically. ● Distinguish between relations and functions that are expressed algebraically and graphically. ● Recognize restricted/discontinuous domains and ranges. ● Use interchange of variables to find the inverse of a function. ● Find the composition of two functions. ● Use graphing technology to investigate functions and to solve real world problems.

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Rational and Radical Functions

Standards: AFM.6

Prerequisite Knowledge	Objectives
[AII.1a](#), [AII.1b](#) [AII.3c](#), [AII.3d](#) [AII.7a](#), [AII.7b](#), [AII.7c](#), [AII.7d](#), [AII.7e](#), [AII.7f](#), [AII.7g](#), [AII.7h](#), [AII.7i](#) [AII.7k](#),	**AFM.6 Identify, graph, and write rational and radical functions and to apply the concepts of rational and radical functions to real world models.** ● Recognize general shapes of rational and radical functions. Find domain, range, and end behavior. This should include point, jump, and infinite discontinuities. ● Add, subtract, multiply, and divide rational expressions whose denominators are monomials or polynomial expressions. ● Simplify a rational expression with common monomial or binomial factors. ● Recognize and simplify a complex fraction. ● Solve equations containing rational expressions both algebraically and graphically. ● Convert from radical notation to exponential notation, and vice versa. ● Simplify radical expressions. ● Add, subtract, multiply, and divide radical expressions. Do not require rationalizing the denominators. ● Solve equations containing radical expression both algebraically and graphically. ● Fit rational and radical functions to data by using algebra and technology.
	AFM.4 Find the domain, range, zeros, and inverse of a function, the value of a function for a given element in its domain, and the composition of multiple functions. ● Identify the domain, range, zeros, and inverse of a function presented algebraically or graphically. ● Distinguish between relations and functions that are expressed algebraically and graphically. ● Recognize restricted/discontinuous domains and ranges. ● Use interchange of variables to find the inverse of a function. ● Find the composition of two functions. ● Use graphing technology to investigate functions and to solve real world problems.

Quarter 3

Unit Circle Trigonometry
Standards: AFM.7, AFM.8, AFM.9, AFM.10

Prerequisite Knowledge	Objectives
G.8a, G.8b, G.8c	**AFM.7 Use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant, and cosecant of an angle in standard position whose terminal side contains a given point.** ● Define the six triangular trigonometric functions of an angle in a right triangle. ● Define the six circular trigonometric functions of an angle in standard position. ● Make the connection between the triangular and circular trigonometric functions. ● Recognize and draw an angle in standard position. ● Show how a point on the terminal side of an angle determines its reference triangle.

	AFM.8 Given the value of one trigonometric function, find the values of the other trigonometric functions.
	● Given one trigonometric function value, find the other five trigonometric function values.
	● Use a calculator to find the value of any trigonometric function and inverse trigonometric function.
	● Develop the unit circle, using both degrees and radians.
	● Solve problems, using the circular function definitions and the properties of the unit circle.
	● Recognize the connections between the coordinates of points on a unit circle and
	    ● coordinate geometry;
	    ● cosine and sine values; and
	    ● lengths of sides of special right triangles (30°-60°- 90° and 45°-45°-90°).
	● Find trigonometric function values of special angles and their related angles in both degrees and radians.
	● Apply the properties of the unit circle without using a calculator.
	● Use a conversion factor to convert from radians to degrees and vice versa without using a calculator.

AFM.9 Analyze and identify key characteristics of trigonometric functions.
- Determine the amplitude, period, phase shift, and vertical shift of a trigonometric function from the equation of the function and from the graph of the function.
- Describe the effect of changing A, B, C, and D in the standard form of a trigonometric equation {e.g., y = A sin(Bx + C) + D or y = A cos(Bx + C) + D} .
- State the domain and the range of a function written in standard form {e.g., y = A sin(Bx + C) + D or y = A cos(Bx + C) + D} .
- Sketch the graph of a function written in standard form {e.g., y = A sin(Bx + C) + D or y = A cos(Bx + C) + D} by using transformations for at least one period or one cycle.
- Utilize a graphing calculator to investigate the effect of changing A, B, C, and D on the graph of a trigonometric function.

AFM.10 Analyze and identify key characteristics of inverse trigonometric functions.
- Find the domain and range of the inverse trigonometric functions.
- Use the restrictions on the domains of the inverse trigonometric functions in finding the values of the inverse trigonometric functions.
- Identify the graphs of the inverse trigonometric functions.

Quarter 4

Analytical Trigonometry Standards: AFM.11, AFM.12

Prerequisite Knowledge	Objectives
	AFM.12 Solve trigonometric equations ● Solve trigonometric equations with restricted domains algebraically and by using a graphing utility. ● Solve trigonometric equations with infinite solutions algebraically and by using a graphing utility. ● Check for reasonableness of results, and verify algebraic solutions, using a graphing utility.
	AFM.11 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.

Applications of Trigonometry

Standards: AFM.13

Prerequisite Knowledge	Objectives
[G.8a](), [G.8b](), [G.8c]()	**AFM.13 Identify, create, and solve practical problems involving triangles.** ● Write a practical problem involving triangles. ● Solve practical problems involving triangles. ● Use the trigonometric functions, Pythagorean Theorem, Law of Sines, and Law of Cosines to solve practical problems. ● Identify a solution technique that could be used with a given problem. ● Find the area of a triangle and use Herron's Formula.