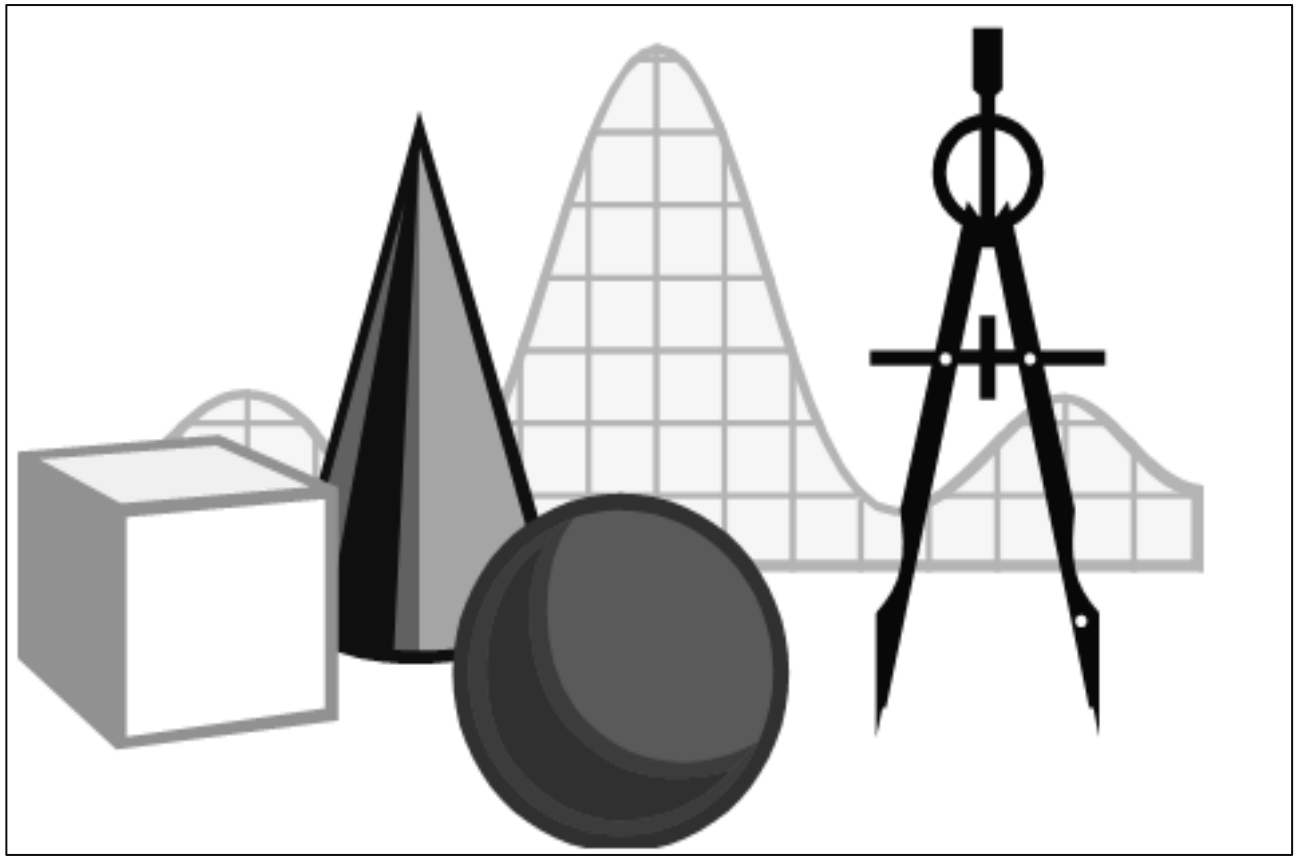

ADVANCED FUNCTIONS AND MODELING CURRICULUM GUIDE

Loudoun County Public Schools

2010-2011

Complete scope, sequence, pacing and resources are available on the CD and will be available on the LCPS Intranet.

INTRODUCTION TO LOUDOUN COUNTY'S MATHEMATICS CURRICULUM GUIDE

This CURRICULUM GUIDE is a merger of the Virginia Standards of Learning (SOL) and the Mathematics Achievement Standards for Loudoun County Public Schools. The CURRICULUM GUIDE includes excerpts from documents published by the Virginia Department of Education. Other statements, such as suggestions on the incorporation of technology and essential questions, represent the professional consensus of Loudoun's teachers concerning the implementation of these standards. In many instances the local expectations for achievement exceed state requirements. The GUIDE is the lead document for planning, assessment and curriculum work. It is a summarized reference to the entire program that remains relatively unchanged over several student generations. Other documents, called RESOURCES, are updated more frequently. These are published separately but teachers can combine them with the GUIDE for ease in lesson planning.

Mathematics Internet Safety Procedures

1. Teachers should review all Internet sites and links prior to using it in the classroom. During this review, teachers need to ensure the appropriateness of the content on the site, checking for broken links, and paying attention to any inappropriate pop-ups or solicitation of information.
2. Teachers should circulate throughout the classroom while students are on the internet checking to make sure the students are on the appropriate site and are not minimizing other inappropriate sites. Teachers should periodically check and update any web addresses that they have on their LCPS web pages.
3. Teachers should assure that the use of websites correlate with the objectives of lesson and provide students with the appropriate challenge.
4. Teachers should assure that the use of websites correlate with the objectives of the lesson and provide students with the appropriate challenge.

Advanced Functions and Modeling Nine Weeks Overview

1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
AFM.1 **AFM.2** **38 days**	**AFM.3** **AFM.4** **AFM.5** **AFM.6** **48 days**	**AFM.7** **AFM.8** **AFM.9** **AFM.10** **48 days**	**AFM.11** **AFM.12** **AFM.13** **AFM.14** **47 days**

Resources: Textbook *College Algebra and Trigonometry*, Fifth Edition, Augmann, Barker, and Nation
Graphic Algebra, Key Curriculum Press, 1998
Mathematical Investigations Book Two, Dale Seymour Publications, 1992
NCSSM Distance Learning-website
Pacesetter Matheamtics Precalculus through Modeling Volume 1, the College Board
Texas Instruments website
Math Smart, Jossey Bass, 2002
Zooming in on Precalculus: Explorations with Technology, D & S Marketing Systems, 2000

Quarter 1: Academic Year 2010-2011 Advanced Functions and Modeling

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
Quarter 1:	**AFM.1** The student will be able to identify, graph, and write linear functions and to apply the concepts of linear functions to real world models. **OBJECTIVES:** The student will be able to: 1. Recognize the solution of a linear equation is the zero of the function. 2. Fit linear functions to data by using algebra and technology. 3. Recognize the special properties of parallel and perpendicular lines. 4. Graph piece-wise linear functions. 5. Graph absolute value equations in two variables and recognize them as piece-wise linear functions. 6. Find domain, range, end behavior, symmetry of linear functions.	Stack of Cups- Pacesetter Mathematics or Spaghetti Bridge- Mathematical Investigations	Activities: Mathematical Investigations o Penny Bridge- o Life Expectancy o Payoff Piece-wise Functions Textbook Section 2.2 o Postage o Price of gas o Electric meter o First class mail (p. 191) o Income tax (p. 192)

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.2 The student will be able to identify, graph, and write quadratic functions and to apply the concepts of quadratic functions to real world models. **OBJECTIVES:** The student will be able to: 1. Graph quadratic equations by using the vertex and axis of symmetry, vertex/standard form, and transformations. 2. Select an appropriate strategy for solving a quadratic equation (factoring, completing the square, using the quadratic formula, or graphing). 3. Recognize the solution(s) of a quadratic equation is/are the zero(s) of the function. 4. Fit quadratic functions to data by using algebra and technology. 5. Solve a quadratic equation over the set of complex numbers. 6. Find domain, range, end behavior, symmetry of quadratic functions.	Textbook Section 2.4 pp. 223-227 Textbook Section 2.7 pp. 263-267	Activities: • Pennies in a Circle- Mathematical Investigations • Number of points on circle vs Number of points drawn Mathematical Investigations o Projectile motion o Quadratic Functionsc2u4 Mathematical Investigations o Shot put-Pacesetter Mathematics o Rectangular Enclosures o Fences- Pacesetter Mathematics o Holding Pen o Braking distance-Graphic Algebra o Cost of operating a ship-Graphic Algebra o Invention Kitchen Gadget - Cost versus profit of creating new invention- Graphic Algebra o Sydney Harbor Bridge example- Graphic Algebra o Falling objects- Graphic Algebra o TI website: "Areas of Rectangles with Fixed Perimeter"
	Assessment, Enrichment, and Remediation		

Quarter 2: Academic Year 2010-2011 Advanced Functions and Modeling

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
Quarter2:	**AFM.3** The student will be able to identify, graph, and write polynomial functions and to apply the concepts of polynomial functions to real world models. **<u>OBJECTIVES:</u>** The student will be able to: 1. Recognize general shapes and end behavior of polynomial functions. 2. Graph polynomial functions by including relative extrema. 3. Recognize the solution(s) of a polynomial equation is/are the zero(s) of the function. 4. Fit polynomial functions to data by using algebra and technology. 5. 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 6. Write a polynomial function given zero(s). 7. Find domain, range, end behavior, symmetry of polynomial functions.	Oranges Stacked in a Square Based Pyramid- Mathematical Investigations or Barbie© Bungee- Mathematical Investigations	Activities: ○ Textbook Section 3.2 ○ p. 302 #47-51 ○ Box problem (Maximize volume) ○ Maximize profit ○ TI website: "Explore End Behavior" (1.5) Polynomial Functions and Models- Mathematical Investigations ○

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.4 The student will be 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. Functions will include exponential, logarithmic, and those that have domains and ranges that are limited and/or discontinuous. The graphing calculator will be used as a tool to assist in investigation of functions and to solve real world problems. **OBJECTIVES:** The student will be able to: 1. Identify the domain, range, zeros, and inverse of a function presented algebraically or graphically. 2. Distinguish between relations and functions that are expressed algebraically and graphically. 3. Recognize restricted/discontinuous domains and ranges. 4. Use interchange of variables to find the inverse of a function. 5. Find the composition of two functions.	Conversion between Celsius and Fahrenheit- Mathematical Investigations	Activities: • Temperature Scales- Pacesetter Mathematics • Unit Conversions- Mathematical Investigations • Kilometers/miles- Mathematical Investigations • Cryptography – In coding & Decoding- Mathematical Investigations • Textbook Section 4.1 p. 366 #53-54 ○ Using a Number Box Cipher Code breaking- Math Smart •

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.5 The student will be able to identify, graph, and write exponential and logarithmic functions and to apply the concepts of exponential and logarithmic functions to real world models. **<u>OBJECTIVES:</u>** The student will be able to: 1. Recognize general shapes of exponential and logarithmic functions. This should include common and natural logarithms. Find domain, range, and end behavior. 2. Graphically and algebraically recognize that exponential and logarithmic functions are inverses of each other. 3. Fit exponential and logarithmic functions to data by using algebra and technology. 4. Solve exponential and logarithmic equations by applying properties of exponents and logarithms. 5. Investigate logistic growth models.	Textbook Exponential & Logarithmic Functions: Hurricane Fran or Harry Casey and the Pennsylvania Lottery- Pacesetter Mathematics	Activities: • M & Ms/Penny Half-Life- Mathematical Investigations • Bacteria: Log Rhythms, or Half a Log is Better than None! Zooming in Precalculus Investigations • Buying a New Car Zooming in Precalculus Investigations • Credit Card Payoff Zooming in Precalculus Investigations • Loan Payoff Zooming in Precalculus Investigations ○ Thickness of Ozone Layer over time- Graphic Algebra • TI website: "Carbon dating" • TI website: "Height of Bouncing Balls" • A Powerful Function- Pacesetter Mathematics • Population Growth- Pacesetter Mathematics • Textbook Section 4.5 pp. 415-418 Section 4.6 pp. 430-434 ○ Newton's Law of Cooling ○ Movie Contract- Graphic Algebra
	Assessment, Enrichment, and Remediation		

Quarter 3: Academic Year 2010-2011 Advanced Functions and Modeling

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
Quarter 3:	**AFM.6** The student will be able to identify, graph, and write rational and radical functions and to apply the concepts of rational and radical functions to real world models. **<u>OBJECTIVES:</u>** The student will be able to: 1. Recognize general shapes of rational and radical functions. Find domain, range, and end behavior. This should include point, jump, and infinite discontinuities. 2. Add, subtract, multiply, and divide rational expressions whose denominators are monomials or polynomial expressions. 3. Simplify a rational expression with common monomial or binomial factors. 4. Recognize and simplify a complex fraction. 5. Solve equations containing rational expressions both algebraically and graphically. 6. Convert from radical notation to exponential notation, and vice versa. 7. Simplify radical expressions. 8. Add, subtract, multiply, and divide radical expressions. Do not require rationalizing the denominators. 9. Solve equations containing radical expression both algebraically and graphically. 10. Fit rational and radical functions to data by using algebra and technology.	Planning a Summer Camp- Pacesetter Mathematics	Activities: ○ Weather Balloon Take-off- Graphic Algebra ○ Sharing Chocolates- Graphic Algebra ○ Area of a Farm Field- Graphic Algebra ○ Scuba Diving- Graphic Algebra • Wind Chill (Chilly Today, Hot Tamale) Zooming in Precalculus Investigations • Cost/Benefit Professor Rust with RUBRIC- Mathematical Investigations • Textbook Section 3.5 • pp. 342-344 ○ Average Cost #53-54

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.7 The student will be able to 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. Circular function definitions will be connected with trigonometric function definitions. **OBJECTIVES:** The student will be able to: 1. Define the six triangular trigonometric functions of an angle in a right triangle. 2. Define the six circular trigonometric functions of an angle in standard position. 3. Make the connection between the triangular and circular trigonometric functions. 4. Recognize and draw an angle in standard position. 5. Show how a point on the terminal side of an angle determines its reference triangle.	"Trigonometry and the Astrolabe" – University of Michigan website	Activities: • Textbook Sections 5.1-5.3 pp. 459-499 • TI website: "Linear vs. Angular Speed Lab"

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.8 The student will be able to, given the value of one trigonometric function, find the values of the other trigonometric functions. Properties of the unit circle and definitions of circular functions will be applied. The student will find the values of the trigonometric functions of the special angles and their related angles as found in the unit circle without the aid of a calculating utility. This will include converting radians to degrees and vice versa. **<u>OBJECTIVES:</u>** The student will be able to: 1. Given one trigonometric function value, find the other five trigonometric function values. 2. Use a calculator to find the value of any trigonometric function and inverse trigonometric function. 3. Develop the unit circle, using both degrees and radians. 4. Solve problems, using the circular function definitions and the properties of the unit circle. 5. 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°). 6. Find trigonometric function values of special angles and their related angles in both degrees and radians. 7. Apply the properties of the unit circle without using a calculator. 8. Use a conversion factor to convert from radians to degrees and vice versa without using a calculator.	"Investigating the Unit Circle"- Mathematical Investigations	Activities: • Textbook Section 5.4 pp. 499-511 • TI website: "When a Ruler Isn't Enough"

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.9 The student will be able to, given one of the six trigonometric functions in standard form (e.g., $y = A \sin(Bx + C) + D$ where A, B, C, and D are real numbers), will • state the domain and the range of the function; • determine the amplitude, period, phase shift, and vertical shift; and • sketch the graph of the function by using transformations for at least a one-period interval. The graphing calculator will be used to investigate the effect of changing A, B, C, and D on the graph of a trigonometric function. **OBJECTIVES:** The student will be able to: 1. 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. 2. 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 $y = A \cos(Bx + C) + D$} . 3. State the domain and the range of a function written in standard form {e.g., $y = A \sin(Bx + C) + D$ or $y = A \cos(Bx + C) + D$} . 4. 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.	TI website: "Getting Triggy With It" or TI website: "Changes in Latitude – Modeling a Sine Function"	Activities: Textbook Sections 5.5-5.7 pp. 511-539 • Using Trigonometric Functions to Model Climate – National Institute of Water and Atmospheric Research Mathematical Investigations • Bicycle Wheels • TI website: "The Light Side of Trigonometry"

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.10 The student will be able to identify the domain and range of the inverse trigonometric functions and recognize the graph of these functions. Restrictions on the domains of the inverse trigonometric functions will be included. **<u>OBJECTIVES:</u>** The student will be able to: 1. Find the domain and range of the inverse trigonometric functions. 2. Use the restrictions on the domains of the inverse trigonometric functions in finding the values of the inverse trigonometric functions. 3. Identify the graphs of the inverse trigonometric functions.		Activities: • Textbook Sections 6.5 pp. 591-604
	Assessment, Enrichment, and Remediation		

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
Quarter 4:	**AFM.11** The student will be able to verify basic trigonometric identities and make substitutions using the basic identities. **OBJECTIVES:** The student will be able to: 1. 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.		Activities: • Textbook Sections 6.1-6.3 pp. 553-581

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.12 The student will be able to solve trigonometric equations that include both infinite solutions and restricted domain solutions and solve basic trigonometric inequalities. Graphing utilities will be used to solve equations, to check for reasonableness of results, and to verify algebraic solutions. **OBJECTIVES:** The student will be able to: 1. Solve trigonometric equations with restricted domains algebraically and by using a graphing utility. 2. Solve trigonometric equations with infinite solutions algebraically and by using a graphing utility. 3. Check for reasonableness of results, and verify algebraic solutions, using a graphing utility.		Activities: • Textbook Sections 6.6 pp. 604-620 pp. 615-616 #93-100

Number Of Blocks	Topic and Essential Questions	REQUIRED Critical Thinking Lessons	Additional Instructional Resources
	AFM.13 The student will be able to identify, create, and solve practical problems involving triangles. Techniques will include using the trigonometric functions, the Pythagorean Theorem, the Law of Sines, and the Law of Cosines. **OBJECTIVES:** The student will be able to: 1. Write a practical problem involving triangles. 2. Solve practical problems involving triangles. 3. Use the trigonometric functions, Pythagorean Theorem, Law of Sines, and Law of Cosines to solve practical problems. 4. Identify a solution technique that could be used with a given problem. 5. Find the area of a triangle and use Herron's Formula.	The Discus Throw-Pacesetter Mathematics	Activities: • Textbook Sections 7.1-7.2 pp. 627-649
	Assessment, Enrichment, and Remediation		