Bloomfield Public Schools
Bloomfield, NJ 07003

Curriculum guide

Pre-Calculus Honors and
Pre-Calculus

Prepared by:
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Originally Board Approved: September 9, 2014

Standards Revision: Updated by Kevin Agnew

Conforms to NJSLS and National Common Core Standards

Board Approved: August 22, 2017

Introduction:

Pre-Calculus is a useful and versatile branch of mathematics. The study of the concepts and procedures of pre-calculus deepens students' understanding of algebra and extends their ability to apply algebraic concepts and procedures at higher conceptual levels. Pre-Calculus presents students' with the ability to think and reason mathematically and to use mathematics to solve real world problems.

Overarching Understandings:

To understand the fundamental concepts of algebra, trigonometry, and analytic geometry.

To foreshadow important ideas of calculus.

To show how algebra and trigonometry can be used to model real life problems through understanding, development, and interpretations.

Established Goals: New Jersey Core Curriculum Content Standards

http://www.state.nj.us/education/cccs/2009/

Title of Unit	Unit #1: Functions and Linear Relationships	Grade Level	11, 12
Curriculum Area	Pre-calculus Honors / Pre-calculus	Time Frame	10 Days (H) / 15 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSF.IF.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

HSF.IF.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

HSF.IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

HSF.IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

HSF.IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

HSF.IF.7: Graph functions expressed symbolically & show key features of graph, by hand in simple cases & using technology for more complicated cases.

HSF.IF.7a - Graph linear and quadratic functions and show intercepts, maxima, and minima.

HSF.IF.7b - Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

HSF.BF.1: Write a function that describes a relationship between two quantities.

HSF.BF.1a - Determine an explicit expression, a recursive process, or steps for calculation from a context.

HSF.BF.1b - Combine standard function types using arithmetic operations.

HSF.BF.1c - Compose functions.

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness   __X__ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about functions and linear relations to things that they do in their everyday lives.
T2. Analyze real life situations mathematically.
T3. Become proficient in daily skills involving functions.
T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning

Understandings	Essential Questions
Students will understand that…	**Students will keep considering…**
U1. Algebraic representation can be used to generalize patterns and relationships. U2. The properties of special relations called functions can be used to model and analyze real world applications.	Q1. When is a relation a function? Q2. How is the composite of a function formed? Q3. What is a zero of a function? Q4. How are graphs of functions related? Q5. How are the properties of functions and functional operations useful? Q6. What are characteristics of real world problems that can be modeled using linear relationships? Q7. How do real world problems that are linear differ from real world problems that are not linear?

Acquisition

Knowledge	Skills
Students will know…	Students will be able to…
K1. Domain and range K2. Characteristics of a function K3. How to interpret piecewise functions	S1. Perform operations with functions S2. Evaluate composite functions S3. Determine inverse of functions S4. Calculate roots/zeroes of functions S5. Write linear equations

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria **Performance is judged in terms of...**	Assessment Evidence
T1-4, U1-2, Q1-7	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1-3, S1-5	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Other Assessments ● Presentations Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Have students prepare charts that organize solution points of the equation of a line. Have them fill in a table of values and discuss the relationship between the table, the graph, and the equation.	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Have students discuss some real world applications with positive, zero, or negative slope. Encourage them to come up with examples that use the word slope (like "Ski-slope") and examples that apply the idea of constant increase or decrease (like the pitch of a roof).	TI 83/84 Graphing Calculator
	Suggested Activities	**Suggested Resources**
	Presenting problems on white and smart boards	Smartboard and Smart Notebook
	Application worksheet	
	Review Game	

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:

- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation

- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #2: Systems of Equations and Inequalities	Grade Level	11,12
Curriculum Area	Pre-calculus Honors / Pre-calculus	Time Frame	10 Days (H) / 15 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSA.REI.C.5 - Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

HSA.REI.C.6 - Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

HSA.REI.C.7 - Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.

HSA.REI.D.10 - Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

HSA.REI.D.11 - Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

HSA.REI.D.12 - Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

HSA.CED.A.2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

HSA.CED.A.3 - Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness   __X__ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about systems of equations and inequalities to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that...	**Students will keep considering...**
U1. Patterns and relationships can be represented graphically, numerically, symbolically, or verbally. U2. Real life phenomena can be modeled by systems of equations.	Q1. What is a system of equations? Q2. How can a system of equations be solved algebraically? Q3. What are characteristics of real life phenomena that can be modeled by systems of equations? Q4. In the context of real life problems, what does it mean for a system to have no solution, one solution, or an infinite number of solutions?
Acquisition	
Knowledge Students will know...	**Skills** Students will be able to...
K1. That a system of equations (or inequalities) defines the solution space of the system.	S1. Solve systems of equations by graphing, elimination, and substation. S2. Graph systems of inequalities

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria **Performance is judged in terms of…**	Assessment Evidence
T1-4, U1-2, Q1-4	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1, S1-2	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Other Assessments ● Presentations Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction
	The teaching and learning needed to achieve the unit goals.

	Required Activities	**Required Resources**
	Have students graph 3 systems of equations to discover what the pictorial representations of independent, dependent, and inconsistent systems are.	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Have students use systems of equations to solve a problem such as: Maurice plans to invest $10,500 into two different bonds in order to spread out his risk. The first bond has an annual return of 10%, and the second bond has an annual return of 6%. If Maurice expects an 8.5% return from the two bonds, how much should he invest into each bond?	TI 83/84 Graphing Calculator

	Suggested Activities	**Suggested Resources**
	Graphing calculator activity	Smartboard and Smart Notebook
	Application worksheet	
	Review Game	

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups

- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #3: The Nature of Graphs		Grade Level	11,12
Curriculum Area	Pre-calculus Honors / Pre-calculus		**Time Frame**	20 Days (H) / 25 Days
Developed By	B. Miller			

Desired Results (Stage 1)

Established Goals

HSF.IF.C.7 - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

HSF.IF.C.7.a - Graph linear and quadratic functions and show intercepts, maxima, and minima.

HSF.IF.C.7.b - Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

HSF.IF.C.7.c - Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

HSF.IF.C.9 - Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

HSF.BF.B.3 - Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

HSF.BF.B.4 - Find inverse functions.

HSF.BF.B.4.a - Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse.

HSF.BF.B.4.b - Verify by composition that one function is the inverse of another.

HSF.BF.B.4.c - Read values of an inverse function from a graph or a table, given that the function has an inverse.

HSF.BF.B.4.d - Produce an invertible function from a non-invertible function by restricting the domain.

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness   __X__ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about the nature of graphs to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that...	**Students will keep considering...**
U1. Mathematical models can be used to describe and quantify physical relationships. U2. Real world applications can be derived from studying the nature of graphs w/symmetry and transformations. U3. Multiple representations (graph, table, equation) of a mathematical relation enhance our understanding of the relation	Q1. What are basic graphs with which students should be familiar? Q2. Why are asymptotes important / relevant? Q3. What are even and odd functions? Q4. What is meant by continuity and end behavior? Q5. What are similarities within a family of graphs? Q6. How might we analyze graphs? Q7. How are continuity and the context of the problem related? Q8. In context, what are the implications of the different types of variation?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. Different types of symmetry and how they are represented graphically, algebraically, and numerically. K2. Types of discontinuity and how they are represented graphically, algebraically, and numerically. K3. Direct, joint, and inverse variation.	S1. Sketch graphs of functions S2. Determine horizontal, vertical, and slant asymptotes. S3. Graph rational functions. S4. Graph polynomial, absolute value, and radical inequalities. S5. Identify end behavior of graphs S6. Determine the inverse of a relation or function

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria Performance is judged in terms of…	Assessment Evidence
T1-4, U1-3, Q1-8	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1-3, Q1 - 6	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Other Assessments ● Presentations Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Have students create pictures on graph paper that represent Point Symmetry, Line Symmetry, and Symmetry with respect to the Origin.	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Let students discover the relationship between functions whose graphs are symmetric with respect to the y-axis or origin, and even and odd functions.	TI 83/84 Graphing Calculator
	Have students translate the following parent functions on a coordinate plane: Constant function, Identity function, Polynomial functions, Square root functions, Absolute value functions, and Rational functions.	
	Have students complete practical application problems involving functions like: The velocity v and the maximum height h of water being pumped into the air are related by the equation $v = \sqrt{2gh}$ where g is the acceleration due to gravity (32 feet/second^2). Determine an equation that will give the maximum height of the water as a function of its velocity.	
	Suggested Activities	**Suggested Resources**
	Review Game	Smartboard and Smart Notebook

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups

- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #4: Polynomial and Rational Functions	Grade Level	11,12
Curriculum Area	Pre-calculus Honors / Pre-calculus	Time Frame	15 Days (H) / 20 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSN.CN.C.9 - Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

HSA.APR.C.4 - Prove polynomial identities and use them to describe numerical relationships. *For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity* $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples*

HSA.APR.D.6 - Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with degree of $r(x)$ less than degree of $b(x)$, using inspection, long division, or for more complicated examples, a computer algebra system.

HSA.APR.D.7 - Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

HSA.REI.B.4 - Solve quadratic equations in one variable.

HSA.REI.B.4.a - Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

HSA.REI.B.4.b - Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

HSF.IF.C.7-Graph functions expressed symbolically & show key features of graph, by hand in simple cases & using technology for more complicated cases.

HSF.IF.C.7.a - Graph linear and quadratic functions and show intercepts, maxima, and minima.

HSF.IF.C.7.b - Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

HSF.IF.C.7.c - Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

HSF.IF.C.7.d - Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness   __X__ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about polynomial and rational functions to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.
T3. Become proficient in daily skills involving functions.
T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning

Understandings	Essential Questions
Students will understand that…	**Students will keep considering…**
U1. Algebraic and numerous procedures are interconnected and build on one another to produce a coherent whole. U2. The characteristics of rational functions and their representations are useful in solving real world problems.	Q1. What is the fundamental theorem of algebra? Q2. How can the remainder and factor theorem be used to find roots? Q3. How is the discriminant used to analyze the roots of a quadratic? Q4. How is the rational root theorem used to solve a polynomial equation? Q5. How do you approximate the real zeros of a polynomial function? Q6. How is the rational root theorem used to solve polynomial equations?

Acquisition

Knowledge	Skills
Students will know…	Students will be able to…
K1. The Fundamental Theorem of Algebra and its application for understanding the behavior of mathematical equations.	S1. Calculate the roots of polynomial equations by graphing and algebraically. S2. Solve polynomial inequalities. S3. Use the discriminant to find the nature of the roots of a quadratic. S4. Graph quadratic equations and inequalities. S5. Find factors of polynomials using factor and remainder theorem. S6. Identify all possible rational roots using the rational root theorem. S7. Solve rational and radical equations.

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria Performance is judged in terms of…	Assessment Evidence
T1-4, U1-2, Q1-6	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1, S1-7	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Presentations ● Other Assessments Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Have students discover under what conditions they should use synthetic substitution and when using a computer or graphing calculator is preferable.	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	List different polynomials on the board and have students predict what the graphs would look like	TI 83/84 Graphing Calculator
	Give students a printout of a table of values of a polynomial and ask them to use it to find maximum and minimum values.	
	Using graphing calculators to graph polynomials that are factored. Ask students to characterize the way squared or cubed factors affect the graph of the polynomial.	
	Suggested Activities	**Suggested Resources**
	Applications worksheet	Smartboard and Smart Notebook
	Review Game	

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study

Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest

- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #5: The Trigonometric Functions	Grade Level	11,12
Curriculum Area	Pre-calculus Honors / Pre-calculus	Time Frame	20 Days (H) / 25 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSF.IF.A.2 - Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

HSF.IF.B.4 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

HSG.C.A.2 - Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

HSF.TF.A.1 - Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

HSF.TF.A.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.

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

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

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness   __X__ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about trigonometric functions to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that...	**Students will keep considering...**
U1. Real world data can be modeled by the graphs of trigonometric functions. U2. Physical models can be used to clarify mathematical relationships.	Q1. How are circular functions related to trigonometric function? Q2. What do trigonometric functions represent? Q3. How do we find the values of trigonometric functions? Q4. How are the law of sines and the law of cosines used to solve oblique triangles? Q5. How does trigonometry allow us to find the area of triangles? Q6. How can trigonometric relationships be applied to a variety of real life situations?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. The concepts of coterminal and reference angles. K2. Law of Sines K3. Law of Cosines	S1. Convert decimal degrees of degree, minutes, and seconds S2. Convert from degrees to radians and vice versa S3. Evaluate trigonometric ratios in right triangles S4. Evaluate trigonometric ratios on the unit circle S5. Apply trigonometric ratios to solve right triangle word problems. S6. Solve triangles using law of sines and law of cosines.

Evidence (Stage 2)		
Checks for Alignment	**Evaluation Criteria** **Performance is judged in terms of…**	**Assessment Evidence**
T1-4, U1-2, Q1-6	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure
		Summative ● Quizzes ● Test ● Project
K1-3, S1-6	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Presentations ● Other Assessments
		Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction
	The teaching and learning needed to achieve the unit goals.

	Required Activities	**Required Resources**
	Have students find the angles in a unit circle	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Have student solve for missing components of triangles using law of sines and/or law of cosines	TI 83/84 Graphing Calculator
	Have student develop multiple visual aides to help them remember the value of trig functions at key degree and radian measures.	
	Use Geogebra Applet(s) to see how ratios of right triangles form the 6 trig functions	

	Suggested Activities	**Suggested Resources**
	Application Worksheet	Smartboard and Smart Notebook
	Review Game	Geogebra

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups

- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #6: Graphs and Inverses of the Trigonometric Function	Grade Level	11,12
Curriculum Area	Pre-calculus Honors / Pre-calculus	Time Frame	15 Days (H) / 20 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSF.TF.A.1 - Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

HSF.TF.A.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.

HSF.TF.A.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 x, π + x, and 2π - x in terms of their values for x, where x is any real number.

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

HSF.TF.B.5 - Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*

HSF.TF.B.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.

HSF.TF.B.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.*

HSF.IF.B.4 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

HSF.IF.B.5 - Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

HSF.IF.C.7.e - Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

HSF.IF.C.9 - Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

HSF.BF.B.3 - Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

   X   Global Awareness   X   Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about trigonometric functions to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that...	Students will keep considering...
U1. Real world data can be modeled by the graphs of trigonometric functions. U2. Physical models can be used to clarify mathematical relationships.	Q1. How are the graphs of the six trigonometric functions graphed on the coordinate plane? Q2. What is angular and linear velocity? Q3. How would you write a trigonometric equation to model given data? How are families of graphs related? Q4. Given characteristics of a phenomena how can you determine if a trigonometric model is appropriate and then how can you fit the model to the data?
Acquisition	
Knowledge	**Skills**
Students will know...	Students will be able to...
K1. Relation between algebraic representation of trigonometric function and its graph. K2. Usage of inverse trigonometric function.	S1. Graph all six trigonometric functions with translations, phase shifts, and dilations. S2. Compute algebraically and graphically, amplitude, period, phase shift, and vertical shift. S3. Model real world data using sine and cosine. S4. Apply inverse functions to solve equations in the form $y = a\sin(bx+c)+d$. S5. Find solutions on a given domain as well as over all real numbers.

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria Performance is judged in terms of…	Assessment Evidence
T1-4, U1-2, Q1-4	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1-2, S1-5	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Presentations ● Other Assessments Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Have student use Geogebra Applet to discover how components of y=Asin(Bx+C)+D impact the graph of the trig function	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Have students solve trig equations using inverse trig functions.	TI 83/84 Graphing Calculator
	Have students develop models that involve trig functions.	Geogebra
	Suggested Activities	**Suggested Resources**
	Review Game	Smartboard and Smart Notebook

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups

- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #7: Trigonometric Identities and Equations	Grade Level	11,12
Curriculum Area	Pre-calculus Honors / Pre-calculus	Time Frame	15 Days (H) / 20 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSF.TF.C.8 - Prove the Pythagorean identity $\sin2(\theta) + \cos2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.

HSF.TF.C.9 - Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness   __X__ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about trigonometric functions to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that...	**Students will keep considering...**
U1. Basic trigonometric identities and equations can be used to clarify mathematical relationships. U2. The language of algebra can be applied to trigonometric functions to generalize patterns and relationships. U3. Different forms of mathematics relationships can reveal or obscure various attributes.	Q1. How do Pythagorean triples relate to trigonometric functions? Q2. How are trigonometric identities related to algebraic skills? Q3. How do you identify solutions to trigonometric equations? Q4. What are strategies that can employed when transforming trigonometric relationships and how can you evaluate if these strategies are being effective?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. Key trigonometric identities including: reciprocal, quotient, Pythagorean, symmetry, opposite angle, sum and difference, and double angle.	S1. Use identities to simply expressions S2. Prove new trig identities using established identities. S3. Apply identities in problem situations.

Evidence (Stage 2)		
Checks for Alignment	**Evaluation Criteria** **Performance is judged in terms of…**	**Assessment Evidence**
T1-4, U1-3, Q1-4	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1, S1-3	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Presentations ● Other Assessments Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice

Summary of Key Learning Events and Instruction
The teaching and learning needed to achieve the unit goals.

Required Activities	Required Resources
Have students recognize, identify, and explain the differences between Reciprocal, Quotient, Pythagorean, and Symmetry Identities.	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
Have students develop and discuss strategies that are helpful when trying to prove trig identities.	TI 83/84 Graphing Calculator

Suggested Activities	Suggested Resources
	Smartboard and Smart Notebook
Review Game	

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups

- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #8: Exponential and Logarithmic Functions	Grade Level	11,12
Curriculum Area	Pre-calculus Honors / Pre-calculus	Time Frame	10 Days (H) / 15 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSF.BF.B.5 - Use the inverse relationship between exponents and logarithms to solve problems involving exponents and logarithms.

HSF.LE.A.1.c - Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

HSF.LE.A.2 - Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

HSF.LE.A.3 - Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

HSF.LE.A.4 – Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology

HSF.LE.B.5 - Interpret the parameters in a linear or exponential function in terms of a context.

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness   __X__ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about exponents and logarithms to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	**Students will keep considering…**
U1. The characteristics of exponential and logarithmic functions and their representations are useful in physical models and real world problems. U2. Exponential and logarithmic functions representing relationships with a multiplicative rate of growth or decay.	Q1. What are properties of exponents and logarithms? Q2. How do we use the properties of exponents and logarithms? Q3. How do we solve logarithmic equations? Q4. How do the graphs of logarithmic and exponential equations represent real world problems and their solutions? Q5. How does one identify situations in which an exponential or logarithmic model is appropriate?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. The graphs of logarithmic and exponential expressions. K2. The characteristics of an exponential equation.	S1. Evaluate exponential and logarithmic expressions S2. Solve equations involving exponential or logarithmic terms. S3. Model real life applications with exponential and logarithmic expressions.

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria Performance is judged in terms of…	Assessment Evidence
T1-4, U1-2, Q1-5	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1-2, S1-3	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Presentations ● Other Assessments Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Have students explain the difference between exponential growth and decay, and where each one can be used to model real life situations.	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Have student use Geogebra to discover the graphical representation of function of the form y=a^bx	TI 83/84 Graphing Calculator
	Have students use Geogebra to discover the graphical representation of functions of the form $y=\log_b(a)$	Geogebra
	Suggested Activities	**Suggested Resources**
	Review Game	Smartboard and Smart Notebook
	Application Worksheet	

Strategies for Differentiation

Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives

- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #9: Vectors and Polar Coordinates (* Honors only *)	Grade Level	11,12
Curriculum Area	Pre-calculus Honors	Time Frame	25 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSN.VM.A.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, |v|, ||v||, v).

HSN.VM.A.2 - Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

HSN.VM.A.3 - Solve problems involving velocity and other quantities that can be represented by vectors.

HSN.VM.B.4 - Add and subtract vectors.

HSN.VM.B.4.a - 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.

HSN.VM.B.4.b - Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

HSN.VM.B.4.c - Understand vector subtraction v - w as v + (-w), where -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.

HSN.VM.B.5 - Multiply a vector by a scalar.

HSN.VM.B.5.a - Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx, vy) = (cvx, cvy).

HSN.VM.B.5.b - Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v ≠ 0, the direction of cv is either along v (for c > 0) or against v (for c < 0).

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness __X__ Financial, economic, business, and entrepreneurial literacy _____ Civic Literacy _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about vectors and polar expressions to physics and things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Graphs and models can be used to represent different coordinate systems. U2. Mathematical relationships can be expressed in different forms that can either reveal or obscure aspects of their relationship. U3. Other coordinate systems have their place in mathematics to describe phenomena that is difficult to describe on the Cartesian Coordinate System.	Q1. How are points graphed by polar coordinates? Q2. How can we convert polar coordinates to rectangular coordinates and vice versa? Q3. What are the classical curves? Q4. Why are some real life context best modeled using a polar relationship? Q5. How can vectors model many of the quantities in Physics

Acquisition	
Knowledge	**Skills**
Students will know…	Students will be able to…
K1. Proper mathematical format and notations for both polar expressions and vectors. K2. How to apply vectors to applications in Physics. K3. Vector representations in component and magnitude/direction form	S1. Graph vectors S2. Find position and unit vectors S3. Calculate scalar product and magnitude of a vector S4. Calculate the dot product S5. Determine if two vectors are orthogonal S6. Graph polar coordinates and equations S7. Convert between rectangular and polar coordinates and equations.

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria Performance is judged in terms of...	Assessment Evidence
T1-4, U1-3, Q1-5	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
K1-3, S1-7	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	Other Evidence Formative ● Essays ● Journals ● Rubrics ● Reports ● Presentations ● Other Assessments Summative ● Pre-Assessment ● Journals ● Informal Observations

Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction
	The teaching and learning needed to achieve the unit goals.

	Required Activities	Required Resources
	Have students create an art poster using the graphs of different polar equations.	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Using Geogebra have student combine vectors graphically and then verify their graph by solving algebraically.	TI 83/84 Graphing Calculator
		Geogebra
	Suggested Activities	**Suggested Resources**
	Applications of vectors worksheet	Smartboard and Smart Notebook
	Review Game	

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:
- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups

- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #10: Limits and Introduction to Calculus (* Honors only *)	Grade Level	11,12
Curriculum Area	Pre-calculus Honors	Time Frame	15 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

HSF.IF.B.4 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

HSF.IF.B.6 - Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.

8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.

9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.

9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.

9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.

9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

___X___ Global Awareness   ___X___ Financial, economic, business, and entrepreneurial literacy   _____ Civic Literacy   _____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Students will relate the topics learned about limits and continuity to things that they do in their everyday lives.

T2. Analyze real life situations mathematically.

T3. Become proficient in daily skills involving functions.

T4. Communicate mathematical ideas correctly using the vocabulary of the discipline.

Meaning	
Understandings	**Essential Questions**
Students will understand that...	**Students will keep considering...**
U1. Calculus is the study of change. U2. Patterns can continue to infinity and yet still have a limit as to how big they can get. U3. The behavior of a function as its independent variable approaches a certain value is not necessarily the same as the value of a function when the independent variable reaches that value.	Q1. How are algebraic, graphical, numerical, and contextual representations of values related? Q2. How can we discuss the behavior of a function at points where the function is undefined? Q3. What does it mean for a function to be continuous?
Acquisition	
Knowledge Students will know...	**Skills** Students will be able to...
K1. What it means for the value of a function to be undefined K2. What it means for a function's limit to be "DNE" K3. What it means when a function is not continuous	S1. Find the limit of a function numerically, graphically, and analytically S2. Determine when a function is continuous (formally) S3. Determine where and what type of discontinuity a function has (if any) S4. Determine the end behavior of a function S5. Find the instantaneous rate of change of a function and connect it with the slope of the tangent line S6. Use epsilon-delta definition to show a limit exists or does not exist in linear situations S7. Construct sign charts to determine the behavior (sign) of a function over different intervals.

Evidence (Stage 2)

Checks for Alignment	Evaluation Criteria **Performance is judged in terms of...**	Assessment Evidence
T1-4, U1-3, Q1-3	Blooms Taxonomy ● Knowledge ● Comprehension ● Application ● Analysis ● Synthesis ● Evaluation Rubric	**Transfer Task(s)** Formative ● Book problems ● Worksheets ● Cooperative Solving Activities ● Worksheets ● Do Now ● Closure Summative ● Quizzes ● Test ● Project
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Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Video Lessons – http://calculus-help.com on limits	Textbook: Advanced Mathematical Concepts – Pre-calculus with Applications
	Students explore the limits of various rational functions graphically, numerically, and algebraically.	TI 83/84 Graphing Calculator
	Video – http://calculus-help.com on the limit definition of derivative that explains how to use limits to change average rate of change to instantaneous rate of change.	
	Use Geogebra to graphically see the relation between the behavior of a function (increasing / decreasing, concave up / concave down) and the behavior of the graph of the derivative (sign, increasing/decreasing)	
	Suggested Activities	**Suggested Resources**
		Smartboard and Smart Notebook

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
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- Use think-pair-share groups

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- Tier graphic organizers