

Newport-Mesa Unified School District
Office of Secondary Curriculum and Instruction
High School Course of Study

Course Title		Honors Enhanced Math III with Pre-Calculus				Course Code		M0410-M0411			
Transcript Title:	HNR Enhanced Math III with Pre-Calculus AB			Grades Levels:	9-12		Board Adoption Date:		05/26/2015		
Content Area:	Mathematics			GPA Scale:	4.5		Date Course Submitted:		05/09/2015		
Credential Req:	Mathematics		Graduation Subject Areas:		Math		Applied Skills		Elective		
UC/CSU "A-G" Area Approvals:		C		School Site that wrote and submitted the course:			NHHS				
Recommend Skills:	Math II, Math II Enhanced, Algebra II										
Next course(s):	Advanced Placement Calculus										

COURSE DESCRIPTION (catalog summary):

The purpose of Enhanced Math III with Pre-Calculus is to study the concepts from Math I and Math II with greater depth and to continue to learn more advanced mathematic concepts and skills to prepare students for (Advanced Placement) Calculus AB and BC. Students will be expected to have an understanding of theorems and concepts as well as their applications to the study of the real world. A particular goal is to improve their problem solving and critical thinking skills by requiring students to solve problems that are not simply procedural in nature or a match to problems studied previously. Enhanced Math III students will be taught how to understand mathematics verbally, analytically, numerically, and graphically and be able to present and teach others their knowledge with clarity and brevity. Enhanced Math III with Pre-Calculus combines the trigonometric, geometric, and algebraic concepts studied in Math III and Pre-Calculus courses needed to prepare students for the study of Calculus. Facility with these topics is especially important for students intending to study calculus, physics, and other sciences, and/or engineering in college. This course is highly suggested as preparation before taking a standard Calculus course that would lead to taking an Advanced Placement Calculus exam.

GOALS (expected performance outcomes for students):

The Enhanced Math III with Pre-Calculus course combines standards from the Math III and Pre-Calculus courses into one academic year with an emphasis on preparing students to complete (Advanced Placement) calculus the following year. The Enhanced Math III with Pre-Calculus course is comprised of standards selected from the high school conceptual categories: Modeling, Functions, Number and Quantity, Algebra, and Geometry. It is in Enhanced Math III with Pre-Calculus that students pull together and apply the accumulation of learning that they have from their previous courses. The repertoire of functions is expanded upon to include polynomial, rational, radical, trigonometric functions. The study of right triangle trigonometry expands to include general triangles. Students extend their work from a Math III course to investigate the reciprocal functions secant, cosecant, and cotangent and their graphs and properties. They find inverse trigonometric functions by appropriately restricting the domains of the standard trigonometric functions and use them to solve problems that arise in modeling contexts. Students

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extend their work with complex numbers to see that complex numbers can be represented in the Cartesian plane and that operations with complex numbers have a geometric interpretation. They connect their understanding of trigonometry and the geometry of the plane to express numbers in polar form. Students begin working with vectors, representing them geometrically and performing operations with them. They connect the notion of vectors to the complex numbers. Students also work with matrices and their operations, experiencing for the first time an algebraic system in which multiplication is not commutative. They see the connection between matrices and transformations in the plane, namely, that a vector in the plane can be multiplied by a 2x2 matrix to produce another vector, and they work with matrices from the point of view of transformations. They also find inverse matrices and use matrices to represent and solve linear systems. Students have worked previously with parabolas and circles, they now work with ellipses and hyperbolas. They also work with polar coordinates and curves defined parametrically, and connect these to their work with trigonometry and complex numbers. Finally, students work with more complicated rational functions, graphing them and determining zeroes, y-intercepts, symmetry, asymptotes, intervals for which the function is increasing and decreasing, and maximum or minimum points. All prior experience with functions and geometry is brought together to create models and solve contextual problems. The Mathematical Practice Standards apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations. The purpose is to gain fluency in the language of mathematics and to appreciate mathematics usefulness in making sense of our world.

CALIFORNIA COMMON CORE MATHEMATICS CONTENT STANDARDS AND MATHEMATICAL PRACTICES:

Math 3 Content Standards Overview

Number and Quantity

The Complex Number System

- Use complex numbers in polynomial identities and equations.

Algebra

Seeing Structure in Expressions

- Interpret the structure of expressions.
- Write expressions in equivalent forms to solve problems.

Arithmetic with Polynomials and Rational Expressions

- Perform arithmetic operations on polynomials.
- Understand the relationship between zeros and factors of polynomials.
- Use polynomial identities to solve problems.
- Rewrite rational expressions.

Creating Equations

- Create equations that describe numbers or relationships.

Reasoning with Equations and Inequalities

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- Understand solving equations as a process of reasoning and explain the reasoning.
- Represent and solve equations and inequalities graphically.

Functions

Interpreting Functions

- Interpret functions that arise in applications in terms of the context.
- Analyze functions using different representations.

Building Functions

- Build a function that models a relationship between two quantities.
- Build new functions from existing functions.

Linear, Quadratic, and Exponential Models

- Construct and compare linear, quadratic, and exponential models and solve problems.

Trigonometric Functions

- Extend the domain of trigonometric functions using the unit circle.
- Model periodic phenomena with trigonometric functions.

Geometry

Similarity, Right Triangles, and Trigonometry

- Apply trigonometry to general triangles.

Expressing Geometric Properties with Equations

- Translate between the geometric description and the equation for a conic section.

Geometric Measurement and Dimension

- Visualize relationships between two-dimensional and three-dimensional objects.

Modeling with Geometry

- Apply geometric concepts in modeling situations.

Statistics and Probability

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Interpreting Categorical and Quantitative Data

- Summarize, represent, and interpret data on a single count or measurement variable.

Making Inferences and Justifying Conclusions

- Understand and evaluate random processes underlying statistical experiments.
- Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Using Probability to Make Decisions

- Use probability to evaluate outcomes of decisions.

The Standards for Mathematical Practice apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations. The Standards for Mathematical Practice (MP) represent a picture of what it looks like for students to *do mathematics* in the classroom and, to the extent possible, content instruction should include attention to appropriate practice standards. The table below gives examples of how students can engage in the MP standards in Mathematics III.

**Standards for Mathematical Practice
Students...**

MP1. Make sense of problems and persevere in solving them.

MP2. Reason abstractly and quantitatively.

MP3. Construct viable arguments and critique the reasoning of others. Students build proofs by induction and proofs by contradiction. CA 3.1 (for higher mathematics only).

MP4. Model with mathematics.

Examples of each practice in Mathematics III

Students apply their understanding of various functions to real world problems. They approach complex mathematics problems and break them down into smaller-sized chunks and synthesize the results when presenting solutions.

Students deepen their understanding of variable, for example, by understanding that changing the values of the parameters in the expression $A\sin(Bx+C)+D$ has consequences for the graph of the function. They interpret these parameters in real world context.

Students continue to reason through the solution of an equation and justify their reasoning to their peers. Students defend their choice of a function to model a real world situation.

Students apply their new mathematical understanding to real world problems, making use of their expanding repertoire of functions in modeling. Students also discover mathematics through experimentation and examining patterns in

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data from real world contexts.

MP5. Use appropriate tools strategically.

Students continue to use graphing technology to deepen their understanding of the behavior of polynomial, rational, square root, and trigonometric functions.

MP6. Attend to precision.

Students make note of the precise definition of *complex number*, understanding that real numbers are a subset of the complex numbers. They pay attention to units in real world problems and use unit analysis as a method for verifying their answers.

MP7. Look for and make use of structure.

Students understand the polynomials and rational numbers as sets of mathematical objects that have certain operations and properties. They understand the periodicity of sine and cosine and use these functions to model periodic phenomena.

MP8. Look for and make use of regularity in repeated reasoning.

Students observe patterns in geometric sums, e.g. that the first several sums of

the form $\sum_{n=0}^k 2^n$ can be written:

$1 = 2^1 - 1$; $1 + 2 = 2^2 - 1$; $1 + 2 + 4 = 2^3 - 1$; $1 + 2 + 4 + 8 = 2^4 - 1$, and use this observation to make a conjecture about any such sum.

Common Core Mathematics Standards covered by Math III:

Number and Quantity

The Complex Number System N-CN

Use complex numbers in polynomial identities and equations. [Polynomials with real coefficients; apply N-CN.9 to higher degree polynomials.]

8. (+) Extend polynomial identities to the complex numbers.

9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Algebra

Seeing Structure in Expressions

A-SSE

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Interpret the structure of expressions. [Polynomial and rational]

1. Interpret expressions that represent a quantity in terms of its context.
 - a. Interpret parts of an expression, such as terms, factors, and coefficients.
 - b. Interpret complicated expressions by viewing one or more of their parts as a single entity.
2. Use the structure of an expression to identify ways to rewrite it.

Write expressions in equivalent forms to solve problems.

4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*

Arithmetic with Polynomials and Rational Expressions

A-APR

Perform arithmetic operations on polynomials. [Beyond quadratic]

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Understand the relationship between zeros and factors of polynomials.

2. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Use polynomial identities to solve problems.

4. Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.*
5. (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n , where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

Rewrite rational expressions. [Linear and quadratic denominators]

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 the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
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.

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Creating Equations

A-CED

Create equations that describe numbers or relationships. [Equations using all available types of expressions including simple root functions]

1. Create equations and inequalities in one variable **including ones with absolute value** and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Reasoning with Equations and Inequalities

A-REI

Understand solving equations as a process of reasoning and explain the reasoning. [Simple radical and rational]

2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Represent and solve equations and inequalities graphically. [Combine polynomial, rational, radical, absolute value, and exponential functions.]

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.

Functions

Interpreting Functions

F-IF

Interpret functions that arise in applications in terms of the context. [Include rational, square root and cube root; emphasize selection of appropriate models.]

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

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Analyze functions using different representations. [Include rational and radical; focus on using key features to guide selection of appropriate type of model function.]

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
 - b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
 - c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
 - e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Building Functions

F-BF

Build a function that models a relationship between two quantities. [Include all types of functions studied.]

1. Write a function that describes a relationship between two quantities.
 - b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*

Build new functions from existing functions. [Include simple, radical, rational, and exponential functions; emphasize common effect of each transformation across function types.]

1. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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.*
4. Find inverse functions.
 - 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.

Linear, Quadratic, and Exponential Models

F-LE

Construct and compare linear, quadratic, and exponential models and solve problems.

4. 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. [Logarithms as solutions for exponentials]
- 4.1. Prove simple laws of logarithms.
- 4.2. Use the definition of logarithms to translate between logarithms in any base.
- 4.3. Understand and use the properties of logarithms to simplify logarithmic numeric expressions and to identify their approximate values.

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Trigonometric Functions

Extend the domain of trigonometric functions using the unit circle.

1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
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.
- 2.1 Graph all 6 basic trigonometric functions. CA

Model periodic phenomena with trigonometric functions.

5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline

Geometry

Similarity, Right Triangles, and Trigonometry

G-SRT

Apply trigonometry to general triangles.

9. (+) Derive the formula $A = \frac{1}{2} ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
10. (+) Prove the Laws of Sines and Cosines and use them to solve problems.
11. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Expressing Geometric Properties with Equations

G-GPE

Translate between the geometric description and the equation for a conic section.

- 3.1 Given a quadratic equation of the form $ax^2+by^2+cx+dy+e=0$, use the method for completing the square to put the equation into standard form; identify whether the graph of the equation is a circle, ellipse, parabola, or hyperbola, and graph the equation. [In Mathematics III, this standard addresses only circles and parabolas.] CA

Geometric Measurement and Dimension

G-GMD

Visualize relationships between two-dimensional and three-dimensional objects.

4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

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Modeling with Geometry

G-MG

Apply geometric concepts in modeling situations.

1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Common Core Standards Covered by Pre-Calculus

Conceptual Category: Number and Quantity

The Complex Number System

N-CN

Perform arithmetic operations with complex numbers.

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

Represent complex numbers and their operations on the complex plane.

4. (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.
5. (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. *For example, $(-1 + \sqrt{3}i)^3 = 8$ because $(-1 + \sqrt{3}i)$ has modulus 2 and argument 120° .*
6. (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

Vector and Matrix Quantities

N-VM

Represent and model with vector quantities.

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).
2. (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
3. (+) Solve problems involving velocity and other quantities that can be represented by vectors.

Perform operations on vectors.

4. (+) Add and subtract vectors.
 - a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a

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sum of two vectors is typically not the sum of the magnitudes.

b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

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.

5. (+) Multiply a vector by a scalar.

a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$.

b. Compute the magnitude of a scalar multiple $c\mathbf{v}$ using $\|c\mathbf{v}\| = |c|\mathbf{v}$. Compute the when $|c|\mathbf{v} \neq 0$, the direction of $c\mathbf{v}$ is either along $\mathbf{v}$ (for $c > 0$) or against $\mathbf{v}$ (for $c < 0$).

Perform operations on matrices and use matrices in applications.

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

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

8. (+) Add, subtract, and multiply matrices of appropriate dimensions.

9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.

10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.

11. (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.

12. (+) Work with 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.

Conceptual Category: Algebra

Seeing Structure in Expressions

A-SSE

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context. ★

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P .*

2. Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

Arithmetic with Polynomials and Rational Expressions

A-APR

Rewrite rational expressions.

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 the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

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.

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Creating Equations

A-CED Create equations that describe

numbers or relationships

1. Create equations and inequalities in one variable **including ones with absolute value** and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* **CA★**
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **★**
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. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* **★**
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law $V = IR$ to highlight resistance R .* **★**

Reasoning with Equations and Inequalities

A-REI

Solve systems of equations.

8. (+) Represent a system of linear equations as a single matrix equation in a vector variable.
9. (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3×3 or greater).

Conceptual Category: Functions

Interpreting Functions

F-IF

Interpret functions that arise in applications in terms of the context.

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.* **★**
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 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.* **★**

Analyze functions using different representations.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. **★**
- 7d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. **★**

Trigonometric Functions

F-TF

Expand the domain of trigonometric functions using a unit circle.

4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

Model periodic phenomena with trigonometric functions.

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.

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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. ★

Prove and apply trigonometric identities.

9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

10. (+) **Prove the half angle and double angle identities for sine and cosine and use them to solve problems. CA**

EVALUATION (*how the effectiveness of the course will be monitored and assessed*): Overall effectiveness will be determined by the scores earned by students taking the mathematics portion of the Smarter Balanced Assessment. Students will be assessed by district/teacher created end of unit summative tests and evaluated against a rubric. Students will also complete performance tasks periodically.

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Functions and Their Inverses: Unit 1	Length of Unit ... 10 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
Students will develop the concept of inverse functions in a linear modeling context using tables graphs and equations. Students will extend the concept of inverse functions in a quadratic modeling context with a focus on domain and range and whether function is available a given domain. Students will solidify the concept of inverse function in an exponential modeling context and surface ideas about logarithms. Students will use function machines to model functions and their inverses. The focus will be on finding inverse functions and verifying the two functions are inverses. Students will use tables, graphs and equations and written descriptions of functions to match functions and their inverses together and to verify the inverse relationship between two functions.	One to one Function Horizontal Line Test Inverse Function Properties of Exponential Functions Number e	F.IF 4, 5, 6, 7, 7b A.CED 1, 4 F.BF 1, 1b, 4a A.REI 11 A.SSE 1ab, 2 A.CED 1, 2	<i>See after unit 11 description.</i>	Pre-Calculus: Enhanced with Graphing Utilities 3 rd edition Chapter 2 pages 81-172, will be used as an additional resource for procedural, computational, modeling, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit. (Equivalent in 6 th edition sections 2.1-2.6) Math III Irvine Math Project Unit 6 Generalizing Functions Mathematics Vision Project Module 1 Functions and Their Inverses http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod1_funinv_se31213.pdf will be used as an additional resource for procedural, computational, modeling, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit.

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Differentiation	Support -- for students who are struggling with the content	Content: Unit 1 Process: Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos Product: Proficiency in Unit 1 content
	Extension – for high achieving students.	Content: Unit 1 Process: Robust and differentiated problem solving Product: Solutions to real world and mathematical problems
Evaluation	Formative Assessments (ongoing & mid-lesson): Used to assess student understanding of Math III with Pre-Calculus common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.	
	Summative Assessments (unit final evaluation): Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.	

Logarithmic Functions: Unit 2	Length of Unit ... 8 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
The unit will build upon their Unit 1 study of functions and their inverses by finding the inverses of exponential functions which were studied in Math I and Math II. Students will evaluate and compare logarithmic expressions. Students will graph logarithmic functions with	Base Logarithm Natural Logarithm Properties of Logarithms Change of Base Formula	A.SSE 4 F.LE 4, 401, 402, 403 A.CED 2 A.REI 11	See after unit 11 description.	Pre-Calculus: Enhanced with Graphing Utilities 3rd edition Chapter 4 pages 301-365, will be used as an additional resource for procedural, computational, modeling, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit. (Equivalent in 6th edition sections 5.1-5.9)

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transformations. Students will develop an understanding of log properties. Students will use log properties to evaluate expressions. Students will solve exponential and logarithmic equations analytically and by using technology.	Compounding Interest Logistic Growth	F.IF 5, 6, 7, 7e, 9 F.BF 1, 1b, 4a		Mathematics Vision Project Module 2 Logarithmic Functions http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod2_logfun_se_041214.pdf Irvine Math Project Unit 4 Exponential and Logarithmic Functions	
Differentiation	Support -- for students who are struggling with the content	Content: <i>Unit 2</i> Process: <i>Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos</i> Product: <i>Proficiency in Unit 2 content</i>			
	Extension – for high achieving students.	Content: <i>Unit 2</i> Process: <i>Robust and differentiated problem solving</i> Product: <i>Solutions to real world and mathematical problems</i>			
Evaluation	Formative Assessments (ongoing & mid-lesson): <i>Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.</i>				
	Summative Assessments (unit final evaluation): <i>Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.</i>				

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Unit 3	Length of Unit ... 7 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
Polynomial Functions The unit will build upon previous work in Math I and II where students studied linear and quadratic functions. Students will compare growth rates of linear, quadratic and cubic functions and recognize that cubic functions can be created from the sums of a quadratic function. Students will determine the slowest to the fastest-growing functions by ordering and comparing values as x approaches infinity. Students will understand and behavior and compare and behavior of functions in different representations. Students will use graphical representations to add, subtract, and multiply polynomials. Students will determine the nature of the roots of the polynomial and apply the Fundamental Theorem of Algebra which is building on their study of roots of quadratic and linear functions. Students will experiment with the Binomial Expansion Theorem using Pascal's triangle. Students will be able to apply the Fundamental Theorem of Algebra to	Quadratic Function Power Function Polynomial Function Zeros Factor Theorem Rational Zeros Theorem Intermediate Value Theorem Fundamental Theorem of Algebra Conjugate Pairs Theorem Binomial Expansion Theorem	A.APR 6, 7 A.CED 1 F.BF 1, 1b N.CN 8, 9 A.SSE 1, 2 A.REI 11 F.IF 9, 7, 7c, 5, 6	<i>See after unit 11 description.</i>	Textbook: Mathematics Vision Project Module 3 Polynomial Functions http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod3_polyfun_se_32414.pdf Pre-Calculus: Enhanced with Graphing Utilities Chapter 3 pages173-213 and 236-270, will be used as an additional resource for procedural, computational, modeling, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit. (Equivalent in 6th edition sections 3.1-3.5, 4.1-4.2, 4.5) Math III Irvine Math Project Unit 1 Polynomial Functions, Expressions, and Equations

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polynomial functions and use the Remainder theorem to find all linear factors and roots of a polynomial function. Students will then practice all concepts related to graphing and solving polynomial functions and inequalities.					
Differentiation	Support -- for students who are struggling with the content	Content: Unit 3 Process: Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos Product: Proficiency in Unit 2 content			
	Extension – for high achieving students.	Content: Unit 2 Process: Robust and differentiated problem solving Product: Solutions to real world and mathematical problems			
Evaluation	Formative Assessments (ongoing & mid-lesson): Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.				
	Summative Assessments (unit final evaluation): Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.				

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Unit 4	Length of Unit ... 7 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Rational and Radical Functions</i> Students will be introduced to rational functions within the context of inverse variation. Students will analyze the characteristics of various family sub-functions to assist in identifying characteristics of rational functions. Students will connect rational expressions to rational numbers. Students will be able to identify and behavior of rational functions. Students will be able to graph rational functions by identifying key features: domain, range, intercepts, vertical and oblique asymptotes, end behavior, horizontal asymptotes, and points of discontinuity. Many of the key features that were listed have been studied in terms of polynomial functions. In particular end behavior was introduced in Unit 3. Students will graph using transformations and find the domain of radical functions. Students will solve rational and radical equations and rational inequalities. Students use the graphs of rational and radical functions to solve rational and radical inequalities.	Rational Function Radical function Vertical, Horizontal, and Oblique Asymptotes Holes Continuity and Discontinuity	A.SEE 1, 2 A.APR 6, 7+ A.CED 1, 2, 3, 4 A.REI 2, 11 A.CED 1, 2 F.BF 1 F.IF 5, 6, 7, 9, 7d+	<i>See after unit 11 description.</i>	Math III Irvine Math Project Units 2 and 3 Polynomial and Radical Functions, Expressions, and Equations Textbook: Mathematics Vision Project Module 4 Rational Functions http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod4_ratifun_62114.pdf Pre-Calculus: Enhanced with Graphing Utilities 3rd edition Chapter 3 pages 214-271, will be used as an additional resource for procedural, computational, modeling, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit. (Equivalent in 6th edition sections 4.3-4.6)

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Differentiation	Support -- for students who are struggling with the content	Content: Unit 4 Process: Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos Product: Proficiency in Unit 4 content			
	Extension – for high achieving students.	Content: Unit 4 Process: Robust and differentiated problem solving Product: Solutions to real world and mathematical problems			
Evaluation	Formative Assessments (ongoing & mid-lesson): Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.				
	Summative Assessments (unit final evaluation): Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.				

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Unit 5	Length of Unit ... 10 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Trigonometric Functions</i> Students will use reference triangles, right triangle trigonometry and the symmetry of a circle to find the y coordinates of points on a circular path at given instances of time. Students will extend the definition of sine from a right triangle trigonometry ratio to a function of an angle of rotation. Students will graph a sine function to model circular motion and relate features of the graph to the parameters of the function. Students will extend the definition of cosine from a right triangle trigonometry ratio they function of an angle of rotation. Students will be introduced to radians as a unit for measuring angles on concentric circles. Students will use the proportionality relationship of radian measure to locate points on concentric circles. Students will redefine radian measure of an angle as the length of the intercepted arc on a unit circle. Students will define sine and cosine on the unit circle in terms of angles of rotation measured in radians. Students will be introduced to the horizontal shifts of trigonometric functions in terms of a modeling context. Students will use trigonometric graphs and functions to model periodic behavior. Students	Angle in standard position Degree Radian Six Trigonometric Functions Periodic Function Period, Amplitude, Phase Shift Arc length Unit Circle Fundamental Trigonometric Identities Properties of all 6 Trigonometric Functions Sinusoidal and Trigonometric function	A.REI 11 F.IF 6, 7, 7e, 9 F.BF 1, 1b, 4a F.LE 1, 2, 2.1, 5	<i>See after unit 11 description.</i>	Math III Irvine Math Project Unit 5 Trigonometry Textbook: Mathematics Vision Project Module 6 Trigonometric Functions http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod6_trigfun_se_31014.pdf Pre-Calculus: Enhanced with Graphing Utilities Chapters 5 and 6 pages 367-475, will be used as an additional resource for procedural, computational, modeling, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit.

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will extend the definition of tangent of a right triangle trigonometric ratio to a function of an angle of rotation, including angles of rotation measured in radians on the circle. Students can classify sine, cosine and tangent functions as even or odd. Students will graph the cotangent, cosecant, and secant functions and explore the properties of these reciprocal functions.	graphs				
Differentiation	Support -- for students who are struggling with the content	Content: Unit 5 Process: Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos Product: Proficiency in Unit 5 content			
	Extension – for high achieving students.	Content: Unit 5 Process: Robust and differentiated problem solving Product: Solutions to real world and mathematical problems			
Evaluation	Formative Assessments (ongoing & mid-lesson): Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.				
	Summative Assessments (unit final evaluation): Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.				

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Unit 6	Length of Unit ... 8 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Trigonometric Equations, Formulas and Inverses</i> Students will be able to find the value expressions involving inverse sine, cosine, tangent, cotangent, secant, and cosecant. Student know the domains and ranges of the inverse trigonometric functions and can explain the reason for their restrictions. A student can use a calculator to evaluate inverse trigonometric expressions. Students can use known trigonometric identities to prove new ones. Students can use the sum, difference, double angle, half angle, product to sum, and sum to product formulas. Students will solve a variety of trigonometric equations: single trigonometric function, using identities, quadratic form, linear sine and cosine, using a graphing utility, restricted or unrestricted domains	Inverse trigonometric functions Trigonometric identities: product, sum, difference, half angle, double angle, product to sum, sum to product	F.IF 1, 2, 2.1, 5, 7e F.TF 4+, 5+, 6+, 7+, 8+, 9+, 10+ G.SRT 10, 11	<i>See after unit 11 description.</i>	Textbook: Mathematics Vision Project Module 6 Trigonometric Functions http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod6_trigfun_se_31014.pdf Textbook: Pre-Calculus: Enhanced with Graphing Utilities 3rd edition Chapter 6 pages 457-525 will be used as a resource for procedural, computational, modeling, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit. (Equivalent in 6th edition sections 7.1-7.7)
Differentiation	Support -- for students who are struggling with the content	Content: <i>Unit 6</i> Process: <i>Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos</i> Product: <i>Proficiency in Unit 6 content</i>		
	Extension –	Content: <i>Unit 6</i>		

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	for high achieving students.	Process: <i>Robust and differentiated problem solving</i> Product: <i>Solutions to real world and mathematical problems</i>
Evaluation	Formative Assessments (<i>ongoing & mid-lesson</i>): <i>Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.</i>	
	Summative Assessments (<i>unit final evaluation</i>): <i>Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.</i>	

Unit 7 (optional)	Length of Unit ... 5 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Modeling with Functions</i> Students will examine the transformations of a variety of familiar functions using tables. Students will predict the shape of a graph as the sum or product of familiar functions. Students will combine a variety of functions using arithmetic operations to model complex behavior. Students will examine function transformations by composing and decomposing functions. Students will combine functions defined by tables, graphs, or equations using function composition and/or arithmetic operations. All of the function types studied in this unit have been studied		A.CED 1-4	See after unit 11 description.	Textbook: Mathematics Vision Project Module 7 Modeling with Functions http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod7_mdifun_se_51914.pdf

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individually in previous units, but have not been combined using various operations.				
Differentiation	Support -- for students who are struggling with the content	Content: <i>Unit 7</i> Process: <i>Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos</i> Product: <i>Proficiency in Unit 7 content</i>		
	Extension – for high achieving students.	Content: <i>Unit 7</i> Process: <i>Robust and differentiated problem solving</i> Product: <i>Solutions to real world and mathematical problems</i>		
Evaluation	Formative Assessments (ongoing & mid-lesson): <i>Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.</i>			
	Summative Assessments (unit final evaluation): <i>Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.</i>			

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Unit 8	Length of Unit ... 7 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Modeling with Geometry</i> Students will begin by visualizing two-dimensional cross-sections of three-dimensional objects. Student will visualize solids of revolution. Students will approximate the volume of solids of revolution with cylinders and frustums. Students will solve problems using geometric modeling. Students will examine the relationship of sides in special right triangles. Students will develop strategies for solving non-right triangles. Students will examine the Law of Cosines and the Law of Sines. Students will find the missing sides, angles and area of general triangles.	Law of Sines Law of Cosines Area of a Triangle Formulas (SSS, SAS) Ambiguous Case Complementary Angle Theorem Volume	G.SRT 9+, 10+, 11+ G.GMD 4 G.MG 1, 2, 3	<i>See after unit 11 description.</i>	Textbook: Mathematics Vision Project Module 5 Modeling with Geometry http://www.mathematicsvisionproject.org/uploads/1/1/6/3/11636986/sec3_mod5_modgeo_se_041114.pdf Pre-Calculus: Enhanced with Graphing Utilities Chapter 7 pages 527-580, will be used as an additional resource for procedural, computational, modeling, problem solving, and writing problems when the teacher deems it necessary to give students more opportunities to engage with the concepts and skills studied in the unit. (Equivalent in 6 th edition 8.2-8.4)
Differentiation	Support -- for students who are struggling with the content	Content: <i>Unit 8</i> Process: <i>Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos</i> Product: <i>Proficiency in Unit 8 content</i>		
	Extension – for high achieving students.	Content: <i>Unit 8</i> Process: <i>Robust and differentiated problem solving</i>		

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	Product: <i>Solutions to real world and mathematical problems</i>
Evaluation	Formative Assessments (<i>ongoing & mid-lesson</i>): <i>Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.</i>
	Summative Assessments (<i>unit final evaluation</i>): <i>Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.</i>

Unit 9	Length of Unit ... 8 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Polar Coordinates and Vectors</i> Students will begin by plotting polar coordinates and converting between polar coordinates/equations and rectangular coordinates/equations. Students can identify polar equations and graph them by plotting points or using a graphing utility. Students can test the polar equations for symmetry. Complex numbers will be converted from rectangular form to polar form and plotted in the complex plane. Students will find the products and quotients of complex numbers in polar form and apply DeMoivre's Theorem. Students can find complex roots. Students will be introduced to vectors and their applications to other sciences. Students can graph and add and	Polar coordinates Pole Polar axis Polar form of a complex number De Moivre's Theorem Nth root of a complex number Vector Position vector Unit vector	N.CN 3+, 4+, 5+, 6+ F.IF 5 N.VM 1+, 2+, 3+, 4abc+, 5ab+	<i>See after unit 11 description.</i>	Textbook: Pre-Calculus: Enhanced with Graphing Utilities 3 rd Edition Chapter 8 pages 581-659 will be used as a resource for procedural, computational, modeling, problem solving, and writing problems. (Equivalent 6 th edition section 9.1-9.7)

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subtract a vector. Students can find a position vector, unit vector, scalar product, and magnitude of a vector. Students can find a vector from its direction and magnitude. Students will solve problems of objects in static equilibrium. Students find the dot product, cross product or angle between two vectors. Determine whether two vectors are orthogonal or parallel. Students can decompose a vector into two orthogonal vectors and compute work. Finally, student will study vectors in 3D space. Students know algebraic and geometric properties of the cross product including area of a parallelogram and finding a vector orthogonal to two given vectors.	Dot product Cross product Area of a parallelogram				
Differentiation	Support -- for students who are struggling with the content	Content: Unit 9 Process: Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos Product: Proficiency in Unit 9 content			
	Extension – for high achieving students.	Content: Unit 9 Process: Robust and differentiated problem solving Product: Solutions to real world and mathematical problems			
Evaluation	Formative Assessments (ongoing & mid-lesson): Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.				

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	Summative Assessments (unit final evaluation): <i>Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.</i>
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Unit 10	Length of Unit ... 8 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Polar Coordinates and Vectors</i> Students will begin by plotting polar coordinates and converting between polar coordinates/equations and rectangular coordinates/equations. Students can identify polar equations and graph them by plotting points or using a graphing utility. Students can test the polar equations for symmetry. Complex numbers will be converted from rectangular form to polar form and plotted in the complex plane. Students will find the products and quotients of complex numbers in polar form and apply DeMoivre's Theorem. Students can find complex roots. Students will be introduced to vectors and their applications to other sciences. Students can graph and add and subtract a vector. Students can find a position vector, unit vector, scalar product, and magnitude of a vector. Students can find a vector from its direction and magnitude. Students will solve problems of objects in static equilibrium. Students find the	Polar coordinates Pole Polar axis Polar form of a complex number De Moivre's Theorem Nth root of a complex number Vector Position vector Unit vector Dot product Cross product Area of a parallelogram	G.GPE 3.1	See after unit 11 description.	Textbook: Pre-Calculus: Enhanced with Graphing Utilities 3 rd edition Chapter 9 pages 661-701, 718-738 will be used as a resource for procedural, computational, modeling, problem solving and writing problems.

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dot product, cross product or angle between two vectors. Determine whether two vectors are orthogonal or parallel. Students can decompose a vector into two orthogonal vectors and compute work. Finally, student will study vectors in 3D space. Students know algebraic and geometric properties of the cross product including area of a parallelogram and finding a vector orthogonal to two given vectors.					
Differentiation	Support -- for students who are struggling with the content	Content: Unit 10 Process: Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos Product: Proficiency in Unit 10 content			
	Extension – for high achieving students.	Content: Unit 10 Process: Robust and differentiated problem solving Product: Solutions to real world and mathematical problems			
Evaluation	Formative Assessments (ongoing & mid-lesson): Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.				
	Summative Assessments (unit final evaluation): Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.				

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Unit 11	Length of Unit ... 6 block periods			
	Key Vocabulary	Standards (referenced)	Model Tasks	Tools / Texts
<i>Systems of Equations, Inequalities, and Matrices</i> Students will solve systems of 3 equations containing three variables and identify inconsistent systems and dependent equations. Students can compute 2x2 and 3x3 determinants with and without a graphing utility. Students can solve 2 and 3 variable systems using Cramer's rule. Students can compute sum, difference, and product of two matrices, the scalar multiple of a matrix, and the inverse of a 2x2 matrix. Students can compute the inverse of a 3x3 matrix with the aid of a graphing utility. Students can solve a system of equations using the inverse matrix. Students can compute the decomposition of rational expressions with non-repeated or repeated linear factors and quadratic irreducible factors. Students can solve systems of non-linear equations and inequalities.	Consistent Inconsistent Determinant Cramer's Rule Dimension Entry Identity matrix Matrix Inverse of a Matrix Augmented matrix Partial fraction decomposition Solution to non linear system Scalar	N.VM 6+, 7+, 8+, 9+, 10+, 11+, 12+ A.REI 8+, 9+	<i>See after unit 11 description.</i>	Textbook: Pre-Calculus: Enhanced with Graphing Utilities 3rd edition Chapter 10 pages 740-757, 775-834 will be used as a resource for procedural, computational, modeling, problem solving and writing problems.
Differentiation	Support -- for students who are struggling with the content	Content: <i>Unit 11</i> Process: <i>Intervention units, flexible grouping, organizers, and instructional support beyond regular class time, instructional videos</i> Product: <i>Proficiency in Unit 11 content</i>		

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	Extension – for high achieving students. Content: <i>Unit 11</i> Process: <i>Robust and differentiated problem solving</i> Product: <i>Solutions to real world and mathematical problems</i>
Evaluation	Formative Assessments (<i>ongoing & mid-lesson</i>): <i>Used to assess student understanding of Math 3 common core standards in unit 1 and the application of the mathematical practices to determine whether to move forward with lessons or to reteach. Strategies may include, but are not limited to informal checking for understanding, quizzes, performance tasks, and homework review.</i>
	Summative Assessments (<i>unit final evaluation</i>): <i>Typically used to assess student achievement at the end of the unit. Strategies include but are not limited to, district wide unit tests, Smarter Balanced Assessments, a final exam, and a modeling performance task.</i>

Modeling Unit Performance Task Examples

Example 1

It's almost the end of baseball season, and the Good Guys, your favorite team, are in first place with a record of 96 wins and 59 losses. In second place, still in contention, are the Bad Guys, who have 93 wins and 62 losses. No one else is even close. These two teams each have 7 games left, none of which are against each other. What are the chances that they Good Guys will finish in first place?

Prepare a report that convinces the reader that you have found the correct answer. Be sure to include a probability chart and explain how you found some of the cells in that chart (**Make sense of problems and persevere in solving them**). How did you use this chart to help you find the probability of the Good Guys winning? If there is a tie, and a playoff game is needed to determine the winner, how does the probability change? (**Reason abstractly and quantitatively**)

Mathematical Practices Addressed: MP 1 Make sense of problems and persevere in solving them. MP 2 Reason abstractly and quantitatively.

Example 2

Everyone knows that the world's population is increasing. The chart at the left shows the changes over the past several centuries. If this pattern of data continued, how long do you think it would take until we were all squashed up against one another?

Year Estimated Population

1650 470,000,000

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1750 694,000,000

1850 1,091,000,000

1900 1,570,000,000

1950 2,510,000,000

1960 3,030,000,000

1970 3,680,000,000

1980 4,480,000,000

1985 4,870,000,000

1990 5,290,000,000

1995 5,730,000,000

You may find these facts useful.

*The total surface area of the earth is approximately 196,930,000 square miles.

*Approximately 29.2% of the earth's total surface area is land.

In your write up, include a graph of the population. Find a function to approximate the data in the form $y = k * e^{cx}$. Look for better approximations and explain how you arrive at your final function. (Use appropriate tools strategically and Model with mathematics) Discuss whether you think the population data in the table is really exponential and whether you think it will be exponential in the future. **(Make sense of problems and persevere in solving them)** Give reasons for all your conclusions. **(Construct viable arguments)**

Mathematical Practices Addressed: MP1 Make sense of problems and persevere in solving them. MP 3 Construct viable arguments and critique the reasoning of others.

Example 2

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You may have seen or heard about the circus act in which someone dives off a high platform into a small tub of water. Well, the Interactive Circus Troupe has come up with a new wrinkle on this act. They have attached the diver's platform to one of the seats on a Ferris wheel, so that it sticks out horizontally, perpendicular to the plane of the Ferris wheel. The tub of water is on a moving cart that runs along a track, parallel to the plane of the Ferris wheel, and passes under the end of the platform. As the Ferris wheel turns, an assistant holds the diver by the ankles. The assistant must let go at exactly the right moment, so that the diver will land in the moving tub of water.

Here are some facts to consider:

*The Ferris wheel has a radius of 50 feet.

*The center of the Ferris wheel is 65 feet above the ground.

*The Ferris wheel turns counterclockwise at a constant rate, making a complete turn every 40 seconds.

*When the cart starts moving, it is 240 feet to the left of the base of the Ferris wheel.

*The cart moves to the right along the track at a constant speed of 15 feet per second.

*The water level in the cart is 8 feet above the ground.

*The cart starts moving as the platform passes the 3 o'clock position.

*Let $t = 0$ represent the time when the Ferris wheel passes the 3 o'clock position.

*Let W represent the number of seconds that elapse between $t = 0$ and the moment when the diver is released.

For what choice of W will the diver land in the tub of water? Your group should prepare an oral report on your conclusions and how you reached them. **(Construct viable arguments and critique the reasoning of others)** You should also prepare your own write-up of your solution. **(Reason abstractly and quantitatively)** Give variable names to complex expressions that are part of your solution. Feel free to use a graphing calculator to graph these preliminary functions and express your main equation or function in terms of these. **(Attend to precision)**

Mathematical Practices Addressed: MP 2 Reason abstractly and quantitatively. MP 3 Construct viable arguments and critique the reasoning of others. MP 6 Attend to precision.

Below are Open Response Tasks given as example from specific units.

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Unit 1 Open Response Task

Example 1 Flipping Ferraris

When people first learn to drive, they are often told that the faster they are driving, the longer it will take to stop.

So, when you're driving on the freeway, you should leave more space between your car and the car in front of you

than when you are driving slowly through a neighborhood. Have you ever wondered about the relationship between how fast you are driving and how far you travel before you stop, after hitting the brakes?

1. Think about it for a minute. What factors do you think might make a difference in how far a car travels after hitting the brakes?

There has actually been quite a bit of experimental work done (mostly by police departments and insurance companies) to be able to mathematically model the relationship between the speed of a car and the braking distance (how far the car goes until it stops after the driver hits the brakes).

2. Imagine your dream car. Maybe it is a Ferrari 550 Maranello, a super-fast Italian car. Experiments have shown that on smooth, dry roads, the relationship between the braking distance (d) and speed (s) is given by $d(s) = 0.03s^2$. Speed is given in miles/hour and the distance is in feet.

a) How many feet should you leave between you and the car in front of you if you are driving the Ferrari at 55 mi/hr?

b) What distance should you keep between you and the car in front of you if you are driving at 100 mi/hr?

c) If an average car is about 16 feet long, about how many car lengths should you have between you and that car in front of you if you are driving 100 mi/hr?

d) It makes sense to a lot of people that if the car is moving at some speed and then goes twice as fast, the braking distance will be twice as far. Is that true? Explain why or why not.

3. Graph the relationship between braking distance $d(s)$, and speed (s), below.

4. Describe all the mathematical features of the relationship between braking distance and speed for the Ferrari modeled by $d(s) = 0.03s^2$.

5. What if the driver of the Ferrari 550 was cruising along and suddenly hit the brakes to stop because she saw a cat in the road? She skidded to a stop, and fortunately, missed the cat. When she got out of the car she measured the skid marks left by the car so that she knew that her braking distance was 31 ft.

a) How fast was she going when she hit the brakes?

c) If she didn't see the cat until she was 15 feet away, what is the fastest speed she could be traveling before she hit the brakes if she wants to avoid hitting the cat?

6. Part of the job of police officers is to investigate traffic accidents to determine what caused the accident and which driver was at fault. They measure the braking distance using skid marks and calculate speeds using the mathematical relationships just like we have here, although they often use different formulas to account for various factors such as road conditions. Let's go back to the Ferrari on a smooth, dry road since we know the relationship. Create a table that shows the speed the car was traveling based upon the braking distance.

7. Write an equation of the function $s(d)$ that gives the speed the car was traveling for a given braking distance.

8. Graph the function $s(d)$ and describe its features.

Mathematical Practices Addressed: MP 2 Make sense of quantities and their relationships. Contextualize and decontextualize quantitative relationships. MP 4

Apply the mathematics they know to solve everyday problems. MP 5 Use available tools including visual models. MP 6 Express numerical answers with a degree of precision appropriate for the problem context.

Unit 2 Open Response Task

Example 1 Title – Hot Coffee

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A fast food restaurant wants a special container to hold coffee. The restaurant wishes the container to quickly cool the coffee from 200 degrees to 130 degrees and keep the liquid between 110 and 130 degrees as long as possible. The restaurant has 3 containers to choose from: Centikeeper drops the temperature from 200 to 100 degrees in 30 minutes with constant temperature of 70 degrees, Tempcontrol drops the temperature from 200 to 110 degrees in 25 minutes with constant temperature of 60 degrees, HotnCold drops the temperature from 200 to 120 degrees in 10 minutes with constant temperature of 65 degrees. Your job is to recommend a container to the company. Find a function over time relating the temperature of the coffee for each container. How long does it take each container to reduce the coffee to 120 degrees? How long will the coffee be at drinking temperature of 110 to 130 degrees? Explain why you will recommend one container over the others.

Mathematical Practices Addressed: MP 7 Look for the overall structures and patterns in mathematics. MP 8 Look for generalizations and short cuts. Explain how their strategies apply to other situations. MP 6 Communicate precisely with other students and use clear mathematical language when discussing their generalizations. MP 3 Listen to the arguments of others and ask useful questions to determine if their generalizations are correct. MP 1 Monitoring their own approach and changing if necessary.

Unit 3 Open Response Task

Example 1 Title- Sorting Polynomials

Students compare and contrast graphs of polynomials to sort them and learn features including domain, range, absolute minimum, relative maximum, relative minimum, end behaviors, and number of roots/x-intercepts. Using these sorts, students will make *generalizations* about the key features of 2^{nd} , 3^{rd} , 4^{th} and 5^{th} degree polynomials.

Mathematical Practices Addressed: MP 7 Look for the overall structures and patterns in mathematics. MP 8 Look for generalizations and short cuts. Explain how their strategies apply to other situations. MP 6 Communicate precisely with other students and use clear mathematical language when discussing their generalizations. MP 3 Listen to the arguments of others and ask useful questions to determine if their generalizations are correct. MP 1 Monitoring their own approach and changing if necessary.

Unit 4 Open Response or Performance Task

Maddie and Clyde wanted some peace and quiet. Most of all, they wanted privacy. So they left the city and bought a piece of land out in the countryside. They thought what they bought was in the shape of a circle. They decided to plant an orchard on this lot in nice neat rows. First, they planted their first row along an east-west line through the center of the circle. The trees were equally spaced, except that they left out the tree that would have been located at the exact center of the circle. (This is where their home would be). There were 50 trees to the east of the center and 50 to the west. The trees at the ends of these east-west rows were exactly on the boundary of their property. They planted a north-south line of trees through the center, using the same spacing as before and omitting the tree at the center. Again, there were 50 trees to the north of the center and 50 to the south. The trees at the ends of this north-south row were exactly on the boundary of their property. They used each of the trees in their north-south row as the center of an east-west row, filling in the orchard with rows of trees. They always used the same distance between trees in every row. Maddie and Clyde realized that if the trees kept growing, the tree trunks would eventually become so big that it would become impossible to see out from the center of the orchard. As a group, (**Construct viable arguments and critique the reasoning of others**) use the information

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below (**Look for and make use of structure**) to answer the following question: "How soon after they planted the orchard would the center of the lot become a true "hideout"?" Be sure to provide enough evidence to convince the reader of your answer.

*The cross-sectional area of a tree trunk increases by 1.5 square inches per year.

*Right now, the tree trunks each have a circumference of 2.5 inches.

*The unit distance [for instance, the distance from (0, 0) to (1, 0)] is 10 feet.

*The last line of sight is the line that goes from the origin through the point (25, 0.5).

Mathematical Practices Addressed: MP 1 Make sense of problems and persevere in solving them. MP 3 Construct viable arguments and critique the reasoning of others. MP 7 Look for and make use of structure. MP 6 Attend to precision.

Unit 5 Open Response Task

Example 1 – CBL Experiment

Using a CBL, the microphone probe and tuning fork, record the amplitude, frequency, and period of the sound form the graph of the sound created by the tuning fork over time. Write an equation that models the sound form of the graph displayed. Repeat this for multiple tuning forks.

Mathematical Practices Addressed: **MP4. Model with mathematics.** Students apply their new mathematical understanding to real world problems, making use of their expanding repertoire of functions in modeling. Students also discover mathematics through experimentation and examining patterns in data from real world contexts. **MP5. Use appropriate tools strategically.**

Students continue to use graphing technology to deepen their understanding of the behavior of polynomial, rational, square root, and trigonometric functions.

Unit 7 Open Response Task

Example 1 Thrill Ride

You are excited to get to vote on the plans for a proposed new thrill ride at local theme park. The engineers want public input on the design for the new ride. You are one of ten teenagers who have been selected to review the plans based on your good math grades!

As your excitement mounts, the engineers begin their presentation. To your dismay, there are no models or illustrations of the proposed rides— each ride is described only with equations. The equations represent the path a rider would follow through the course of the ride.

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Unfortunately, your cell phone—which contains a graphing calculator app—is completely discharged due to too much texting and surfing the internet. So, you are trying hard to keep up with the presentation by trying to imagine what the graphs of each of these equations would look like. While each equation consists of functions you are familiar with, the combination of functions in each equation has you wondering about their combined effects.

For each of the following proposed thrill rides, use your imagination and best reasoning about the individual functions involved to sketch a graph of the path of the rider. Let y represent the height of the rider above the ground and x represent the distance from the start of the ride. Explain your reasoning about the shape of the graph. (Note: Use radians for trigonometric functions.)

Proposal #1: “The Mountain Climb”

The Equation: $y = -2x + 5\sin 3x$

My Graph:

My Explanation:

Proposal #2: “The Periodic Bump”

The Equation: $y = -10|\sin(x)|$

My Graph:

My Explanation:

Proposal #3: “The Amplifier”

The Equation: $y = -x + 3\sin(x)$

My Graph:

My Explanation:

Proposal #4: “The Gentle Wave”

The Equation: $y = -10(0.9)^x \sin(x)$

My Graph:

My Explanation:

Proposal #5: “The Spinning High Dive”

The Equation: $y = 100 + x^2 + 5\sin(4x)$

My Graph:

My Explanation:

When you got home your friends were all anxiously waiting to here about the proposed new rides. After explaining the situation, your friends all pull out their calculators and they began comparing your imagined images with the actual graphs.

Some of your friends’ graphs differed from the others because of their window settings. Some window settings revealed the features of the graphs you were expecting to see, while other window settings obscured those features.

Examine the actual graphs of each of the thrill ride proposals. Select a window setting that will reveal as many of the features of the graphs as possible. Explain any differences between your imagined graphs and the actual graphs. What features did you get right? What features did you

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miss?

Proposal #1: “The Mountain Climb”

The Equation: $y = 2x + 5\sin x$

Actual Graph:

What features I got right and what I missed:

Proposal #2: “The Periodic Bump”

The Equation: $y = 10\sin(x)$

Actual Graph:

What features I got right and what I missed:

Proposal #3: “The Amplifier”

The Equation: $y = -x + \sin(x)$

Actual Graph:

What features I got right and what I missed:

Proposal #4: “The Gentle Wave”

The Equation: $y = 10(0.9)^x \sin(x)$

Actual Graph:

What features I got right and what I missed:

Proposal #5: “The Spinning High Dive”

The Equation: $y = 100 + x^2 5\sin(4x)$

Actual Graph:

What features I got right and what I missed:

You and your friends decide to propose a different ride to the engineers. Name your proposal and write its equation. Explain why you think the features of this graph would make a fun ride.

My Proposed Ride:

The equation for my ride:

My explanation of my proposal:

Mathematical Practices Addressed: MP 7 Students apply general mathematical patterns and rules they know from prior units studying functions and be able see these new functions as being composed of several simpler objects. MP 5 Use technological tools to deepen their understanding of mathematics.

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Mathematical Practices Addressed: MP 1 Students analyze what is given to explain to themselves the meaning of the problem. MP 3 Students will justify their conclusions with mathematical ideas. MP 4 Students will interpret the results of a mathematical situation.

Example 2 Popcorn

Many students like to eat microwave popcorn as they study for the ACT. Microwave popcorn producers assume that the time it takes for a kernel to pop is distributed normally with a mean of 120 seconds and a standard deviation of 13 for a standard microwave oven. If you're a devoted popcorn studier, you don't want a lot of un-popped kernels, but you know that if you leave the bag in long enough to be sure that all the kernels are popped, some of the popcorn will burn. How much time would you recommend for microwaving the popcorn? Use a normal distribution curve and the features of a normal distribution to explain your answer.

Mathematical Practices Addressed: MP 1 Students analyze what is given to explain to themselves the meaning of the problem. MP 3 Students will justify their conclusions with mathematical ideas. MP 4 Students will interpret the results of a mathematical situation.

Unit 9 Open Task Response

Example 1 – Constructing a Bridge over the East River

A new bridge is to be constructed over the East River in NYC. The space between the supports needs to be 1050 ft; the height of the center of the arch needs to be 350 ft. Two structural possibilities exist: the support could be in the shape of a parabola or the support could be in the shape of a semi-ellipse. An empty tanker needs a 280 ft clearance to pass beneath the bridge. The width of the channel for each of the two plans must be determined to verify that the tanker can pass through the bridge.

- a. Determine the equation of a parabola with these characteristics.
- b. Determine the equation of the ellipse with these characteristics.
- c. How wide is the channel that the tanker passes through in each case.
- d. If the river were to flood and rise 10 feet, how would the clearances be changed for the two bridges. Does this affect the design you will choose. Which design are you going to choose and justify your choice.

MP4 Students apply their new mathematical understanding to real world problems, making use of their expanding repertoire of functions in modeling. Students also discover mathematics through experimentation and examining patterns in data from real world contexts. MP 7 Look for the overall structures and patterns in mathematics. MP 8 Look for generalizations and short cuts. Explain how their strategies apply to other situations. MP 6 Communicate precisely with other students and use clear mathematical language when discussing their generalizations. MP 3 Listen to the arguments of others and ask useful questions to determine if their generalizations are correct. MP 1 Monitoring their own approach and changing if necessary.

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Instructional Methods and/or Strategies

Students will experience a variety of instructional strategies within each unit. The students will use discovery and experimentation to investigate new material and make conjectures. For example, students may be asked to place graphs of functions into categories and make conjectures as to why they grouped them the way they did (MP 1, MP 2, MP 3, MP 7, MP 8). Group and individual presentations will be used for the student to report their findings to the class and allow students to learn from each other (MP 2, MP 3). Students will present the processes that lead to solutions and the reasoning behind the solutions. Students will have experiences in oral and written communication and receive feedback from their peers and teacher. Direct instruction will be used when a topic or skill needs to be explicitly shown or modeled. To be mathematically capable, students must have a facility with the basic techniques of mathematics. There are necessary skills and knowledge that students will routinely exercise without hesitation. Students will be responsible for working together and individually to accomplish tasks. For example, students may work together in cooperative learning groups when using measurement and data collection to analyze real life data, but may be asked to report their findings as an individual or as a group (MP 2, MP 3, MP 4, MP 6). Students will be taught to use technology such as calculators, internet access, and other mathematical software (MP 5) to help derive solutions to linear equations, systems of equations and inequalities, linear regression, scatter plots, and exponential functions. Modeling will be used to help students integrate topic from many units (MP 1). There will be guided practice called Set Problems so that students can learn to understand how they can use the skills or knowledge they learned. Daily Go Problems will be used to continuously integrate, spiral and review material.

Teachers will use a variety of instructional methods that may include:

- modeling mathematical thinking
- visual and graphic descriptions of problems
- systematic and explicit instructions
- student think-aloud
- using hands-on projects and learning activities
- use of structured peer-assisted learning activities involving heterogeneous ability groupings
- problem based learning and problem solving
- determine what they know by identifying what is known, what needs to be find out, what they want to learn based on a given case study scenario
- develop a problem statement which contains steps for solving the problem and factors for determining successful completion
- gather information through online resources, surveys, interviews, observations, measurements, etc.
- develop possible solutions using concept maps, Venn diagrams, graphic organizers, etc.
- presentations for students to demonstrate a solution to the case study based on what was learned
- use graphing calculators (TI-84+ family and TI-Nspire family)

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The following is a summary of the eight MP standards and provides examples of questioning strategies teachers use to support mathematical thinking and student engagement as called for in the MP standards.

MP 1 Make sense of problems and persevere in solving them.

- Interpret and make meaning of the problem to find a starting point.
- Analyze what is given in order to explain to themselves the meaning of the problem.
- Plan a solution pathway instead of jumping to a solution.
- Monitor their own progress and change the approach if necessary.
- See relationships between various representations.
- Relate current situations to concepts or skills previously learned and connect mathematical ideas to one another.
- Continually ask themselves, “Does this make sense?”
- Can understand various approaches to solutions.
- How would you describe the problems in your own words?
- How would you describe what you are trying to find?
- What do you notice about...?
- What information is given in the problem?
- Describe the relationship between the quantities.
- Describe what you have already tried. What might you change?
- Talk me through the steps you’ve used to this point.
- What steps in the process are you most confident about?
- What are some other strategies you might try?
- What are some other problems that are similar to this one?
- How might you use one of your previous problems to help you begin?
- How else might you organize...represent... show...?

MP 2 Reason abstractly and quantitatively.

- Make sense of quantities and their relationships.
- Decontextualize (represent a situation symbolically and manipulate the symbols) and contextualize (make meaning of the symbols in a problem) quantitative relationships.
- Understand the meaning of quantities and flexibly use operations and their properties.
- Create a logical representation of the problem.
- Attend to the meaning of quantities, not just how to compute them.
- What do the numbers used in the problem represent?
- What is the relationship of the quantities?
- How is _____ related to _____?
- What is the relationship between _____ and _____?
- What does _____ mean to you? (e.g. symbol, quantity, diagram)

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- What properties might we use to find a solution?
- How did you decide in this task that you needed to use...?
- Could we have used another operation or property to solve this task? Why or why not?

MP 3 Construct viable arguments and critique the reasoning of others.

- Analyze problems and use stated mathematical assumptions, definitions, and established results in constructing arguments.
- Justify conclusions with mathematical ideas.
- Listen to the arguments of others and ask useful questions to determine if an argument makes sense.
- Ask clarifying questions or suggest ideas to improve/revise the argument.
- Compare two arguments and determine correct or flawed logic.
- What mathematical evidence would support your solution?
- How can we be sure that...? or How could you prove that...?
- Will it still work if...?
- What were you considering when...?
- How did you decide to try that strategy?
- How did you test whether your approach worked?
- How did you decide what the problem was asking you to find? (What was unknown?)
- Did you try a method that did not work? Why didn't it work? Would it ever work? Why or why not?
- What is the same and what is different about...?
- How could you demonstrate a counter-example?
- I think it might be clearer if you said ... Is that what you meant
- Is your method like Shawna's method or how is it different?

MP 4 Model with mathematics.

- Understand this is a way to reason quantitatively and abstractly (able to decontextualize and contextualize).
- Apply the mathematics they know to solve everyday problems.
- Simplify a complex problem and identify important quantities to look at relationships.
- Represent mathematics to describe a situation either with an equation or a diagram and interpret the results of a mathematical situation.
- Reflect on whether the results make sense, possibly improving/revising the model.
- Ask themselves, "How can I represent this mathematically?"
- What math drawing or diagram could you make and label to represent the problem?
- What are some ways to represent the quantities?
- What is an equation or expression that matches the diagram, number line, chart, table..?
- Where did you see one of the quantities in the task in your equation or expression?
- How would it help to create a diagram, graph, table...?
- What are some ways to visually represent...?
- What formula might apply in this situation?

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MP 5 Use appropriate tools strategically.

- Use available tools including visual models, recognizing the strengths and limitations of each.
- Use estimation and other mathematical knowledge to detect possible errors.
- Identify relevant external mathematical resources to pose and solve problems.
- Use technological tools to deepen their understanding of mathematics.
- What mathematical tools could we use to visualize and represent the situation?
- What information do you have?
- What do you know that is not stated in the problem?
- What approach are you considering trying first?
- What estimate did you make for the solution?
- In this situation would it be helpful to use a graph, number line, ruler, diagram, calculator, manipulative...?
- Why was it helpful to use...?
- What can using a _____ show us that _____ may not?
- In what situations might it be more informative or helpful to use...?

MP 6 Attend to precision.

- Communicate precisely with others and try to use clear mathematical language when discussing their reasoning.
- Understand the meanings of symbols used in
- What mathematical terms apply in this situation?
- How did you know your solution was reasonable?
- Explain how you might show that your solution answers the problem.
- What would be a more efficient strategy?

mathematics and can label quantities appropriately.

- Express numerical answers with a degree of precision appropriate for the problem context.
- Calculate efficiently and accurately.
- How are you showing the meaning of the quantities?
- What symbols or mathematical notations are important in this problem?
- What mathematical language, definitions, properties...can you use to explain...?
- Can you say it in a different way?
- Can you say it in your own words? And now say it in math words.
- How could you test your solution to see if it answers the problem?

MP 7 Look for and make use of structure.

- Look for the overall structures and patterns in mathematics. Think about how to describe these in words, math symbols, or visual models.
- See complicated things as single objects or as being composed of several objects. Compose and decompose conceptually.
- Apply general mathematical patterns, rules, or procedures to specific situations.
- What observations can you make about...?
- What do you notice when...?
- What parts of the problem might you eliminate, simplify...?

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- What patterns do you find in...?
- How do you know if something is a pattern?
- What ideas that we have learned before were useful in solving this problem?
- What are some other problems that are similar to this one?
- How does this relate to...?
- In what ways does this problem connect to other mathematical concepts?

MP 8 Look for and express regularity in repeated reasoning.

- See repeated calculations and look for generalizations and shortcuts.
- See the overall process of the problem and still attend to the details in the problem solving steps.
- Understand the broader application of patterns and see the structure in similar situations.
- Continually evaluate the reasonableness of their intermediate results
- Explain how this strategy works in other situations.
- Is this always true, sometimes true or never true?
- How would we prove that...?
- What do you notice about...?
- What is happening in this situation?
- What would happen if...?
- Is there a mathematical rule for...?
- What predictions or generalizations can this pattern support?
- What mathematical consistencies do you notice?
- How is this situation like and different from other situations using this operation?

Assessments Including Methods and/or Tools

Students will experience a variety of assessments in each unit. Daily assignments will be used as a way to assess a student on an ongoing basis. These are used to gain immediate feedback on whether students understand the content of the unit. Shorts quizzes will be used throughout each unit to assess longer term knowledge. Unit tests will be given to assess how well students can integrate all knowledge learned in each unit. These tests will contain longer constructed response questions so as to assess the students' math knowledge and communication skills. These some parts of the assessments will be available to be taken with the use of technology. Other assessment tools will be in the form of group and individual presentations. These can be used to gauge how well the student can communicate their understanding and how they arrive at their conclusions (MP 2, MP 3, MP 4, MP 5, MP 6, MP 7). Students may also be asked to keep an ongoing portfolio that shows examples of how they use the eight mathematical practices throughout each unit. Performance tasks will be given throughout the year and specifically during the modeling units so that the students can demonstrate the ability to use information from various units to solve longer more in depth problems (MP 1, MP 2, MP 3, MP 4, MP 5, MP 6) There will be a cumulative final at the end of each semester.

Open Response Tasks: Students are asked to analyze, problem solve, experiment, make decisions, measure, cooperate with others, present orally, or produce a product.

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Modeling Units: The tasks assigned during the modeling units serve to connect all of the mathematics learned during the previous units into a cohesive whole. Also, these projects are usually grounded in real world situations, and stress applications of the mathematics learned. The students practice using mathematics that

Observational assessment: Teacher observes their students in the classroom setting, monitoring for certain skills or behaviors, and jotting them down when they are evidenced. In this way teachers are able to assess not only their students' academic growth, but also their emotional growth. Typically a teacher might be looking for mastery of some topic, but just as important are the affective traits such as demonstrating a valuing of mathematics, or a positive attitude in the face of difficulty.

Traditional Assessments: regular end of unit exams and quizzes (multiple choices, short answer, and written extended response problems). These assessments will include problems that require students to use the mathematical knowledge and skills gained within a unit to solve problems that are unfamiliar and do not exactly match those of problems seen before. Results are reviewed and analyzed by teachers and administrators to develop a learning plan for students who have not mastered material.