Precalculus

Course Description:

The curriculum from this course is developed from: common-core-math-standards.pdf. This is an elective course. This is a weighted course (.5). The information in this course overview outlines what students should understand and be able to do by the end of two trimesters.

Third Edition *Precalculus* meets all of the standards for a Common Core 4th Year high school math course, and includes an introduction to calculus with functions, graphs, limits, area under a curve, and rates of change. The course is designed similarly to the CPM Core Connections courses. On a daily basis, students work collaboratively with others as they use problem-solving strategies, complete investigations, gather evidence, critically analyze results, and communicate clear and effective arguments while justifying their thinking.

The course is well balanced among procedural fluency (algorithms and basic skills), deep conceptual understanding, strategic competence (problem solving), and adaptive reasoning (application and extension). The course embeds the CCSS Standards for Mathematical Practice as an integral part of each lesson in the course. With the emergence of new technology, many lessons have moved beyond a traditional handheld device and are written with Desmos eTools as an integral component. The curriculum contains several key labs and hands-on activities throughout the course to introduce and connect concepts, with an emphasis on modeling.

The course starts with lessons that introduce the following big ideas of the course: functions, trigonometry, modeling, algebraic manipulation, rates of change, and area under a curve. Each of these major topics reemerges later in the course for students to revisit using new knowledge. For instance, the spring lab introduces modeling with mathematics, teamwork, and periodic functions early in the course. Then it is revisited two more times, connecting the situation to exponential decay and writing equations of trigonometric functions. The dirt bike course introduces area under a curve, optimization, and piecewise functions. This situation reemerges connected to instantaneous rates of change.

A focus on algebra is woven throughout the course. Students investigate equivalent expressions and practice setting up word problems right from the start. In Sections 1.2 and 2.1 students use algebra to manipulate inverse, composite, and piecewise-defined functions as well as investigate characteristics of functions and transformations of functions. Section 3.1 focuses on rewriting expressions, solving complicated equations and systems, and concludes with using algebra to solve word problems. Algebraic manipulation is practiced throughout the rest of the course as students work with limits, rates of change, trigonometric expressions, complex numbers, series, conic sections, and area under the curve.

Careful consideration was given to the sequencing of the concepts in the course to allow for mastery over time while meeting the content standards of a 4th year course. The book is designed to be a year-long course and allows teachers to choose topics that fit the needs of their students. One option using this text is a course that focuses on the 4th year math standards: algebra, functions, trigonometry, complex numbers, conic sections, probability, vectors, and matrices. Another option is a course that focuses on Calculus readiness with topics such as rates of change, limits, and area under the curve.

Mastery Standards:

Graph and/or evaluate piecewise-defined functions.

Determine the sine, cosine, and/or tangent of special angles in the unit circle.

Solve trigonometric equations.

Use sigma notation to represent a sum.

Determine the roots of a polynomial, and solve polynomial equations.

Graph transformations of rational functions, and identify horizontal, vertical and slant asymptotes.

Analyze situations involving exponential functions and logarithmic functions.

Evaluate limits using a table or graph (one-sided limits and limits as a point)

Model and evaluate situations using trigonometric functions.

Simplify trigonometric expressions, verify trigonometric identities, and solve trigonometric equations.

Unit	Description of Unit and Learning Targets
Unit Title: Preparing for your journey Essential Questions: ● Why is it important to be prepared?	Students will……. Learning Targets: ● be able to complete operations with functions, including composition. ● be able to write the equation of the inverse of a function or determine if two given functions are inverses of each other. ● be able to graph and/or evaluate piecewise-defined functions.
Unit Title: Functions and Trigonometry Essential Questions: ● How can understanding transformations and other attributes used to describe function help graph trigonometric functions?	Students will... Learning Targets: ● be able to solve linear systems of equations. ● be able to rewrite expressions with exponents and radicals. ● be able to factor expressions. ● be able to work with radians, degrees, and the unit circle. ● be able to analyze situations involving angular motion. describe functions. ● be able to identify even and odd functions. ● be able to transform functions. ● be able to determine the sine, cosine, and/or tangent of special angles in the unit circle. ● be able to graph or write the equation for one or two transformations of a sinusoidal function.
Unit Title: Algebra and area under a curve Essential Questions: ● How do algebraic manipulation skills help us with concepts in calculus?	Students will... Learning Targets: ● be able to solve basic trigonometric equations or situations. ● be able to graph the sine, cosine, and/or tangent function. ● be able to complete operations with rational expressions. ● be able to simplify complex fractions. ● be able to use *u*-substitution to rewrite expressions or solve equations. ● be able to solve nonlinear systems of equations. ● be able to divide polynomials.

	● be able to use sigma notation.
Unit Title: Polynomial and Rational Functions Essential Questions: ● When is a good time to use rational functions?	Students will... Learning Targets: ● be able to approximate the area under the curve using right or left endpoint rectangles. ● be able to sketch the graph of a polynomial function in factored form. ● be able to write an equation given the *x*-intercepts (or roots) of a polynomial. ● be able to determine the roots of a polynomial or solve polynomial equations. ● be able to graph transformations of rational functions. ● be able to identify horizontal, vertical, and slant asymptotes. ● be able to state the end behavior of a polynomial or rational function.
Unit Title: Exponentials and Logarithms Essential Questions: ● How are exponential and logarithm related?	Students will... Learning Targets: ● be able to graph reciprocal functions and/or identify their asymptotes. ● be able to solve polynomial and rational inequalities. ● be able to analyze situations involving exponential functions (that do not require the use of logarithms). ● be able to rewrite equations of exponential functions in the form $y=a\cdot b^x$ ● be able to understand the inverse relationship between exponents and logarithms. ● be able to use the definition of a logarithm to evaluate expressions. ● be able to rewrite expressions using the properties of logarithms. ● be able to solve basic equations with exponents and logarithms. ● be able to graph basic transformations of the family of logarithms.
Unit Title: Triangles and Vectors Essential Questions: ● Are vectors an efficient way to represent certain data?	Students will... Learning Targets: ● be able to solve more complicated equations with exponents and logarithms. ● be able to graph more complicated transformations of the family of logarithmic functions. ● be able to solve application problems involving exponential functions or logarithms. ● be able to solve triangles using the Law of Sines or the Law of Cosines, including the ambiguous case of the Law of Sines.

	● be able to solve triangles when the ambiguous case of the Law of Sines could possibly apply. ● be able to compute the area of a triangle using the formula $A=\frac{1}{2}ab\sin(C)$ ● be able to determine the magnitude and direction of a vector. ● be able to add, subtract, and scale vectors both graphically and using component form.
Unit Title: Limits and Rates <u>Essential Questions:</u> ● How can limits be used to describe the behavior of a function?	Students will... <u>Learning Targets:</u> ● be able to solve problems involving applications of vectors. ● be able to evaluate limits from a graph (one-sided limits and limits at a point). ● be able to evaluate limits using points determined from an equation by using a table or graph (one-sided limits and limits at a point). ● be able to calculate the average rate of change in a situation (table or equation) where the interval is specified. ● be able to write and simplify an expression for the average rate of change of a function from x to x+h when given h.
Unit Title: Extending Periodic Functions <u>Essential Questions:</u> ● What situations can be modeled using periodic functions?	Students will... <u>Learning Targets:</u> ● be able to calculate instantaneous rate of change. ● be able to use the formal definition of continuity. ● be able to graph or write equations of trigonometric functions with multiple transformations. ● be able to model and evaluate situations using trigonometric functions. ● be able to complete problems involving the reciprocal trigonometric functions. ● be able to simplify trigonometric expressions.
Unit Title: Matrices <u>Essential Questions:</u> ● How can matrices be used to simplify solving more complex problems?	Students will... <u>Learning Targets:</u> ● Be able to verify trigonometric identities. ● be able to apply the angle sum and difference identities. ● be able to apply the double-angle and half-angle identities. ● be able to solve complex trigonometric equations. ● be able to complete basic operations with matrices of appropriate dimensions. ● be able to compute determinants and inverses of 2×2

	matrices by hand, recognizing when a matrix is not invertible. ● be able to interpret the absolute value of the determinant in terms of area (of a triangle or parallelogram). ● be able to represent and solve a system of linear equations as a single matrix equation.
Unit Title: Conics and Parametric Functions <u>Essential Questions:</u> ● How many ways can you slice a cone?	Students will... <u>Learning Targets:</u> ● be able to write the equation of a conic section using the definition or a from a description. ● be able to identify a conic section from its equation and graph the conic section. ● be able to complete the square to rewrite the equation of a conic section in graphing form. ● be able to graph parametrically-defined functions. ● be able to rewrite parametrically-defined functions in rectangular form.