

Pequannock Township School District

Curriculum Syllabus

Precalculus

Course Description:

This course is designed to cover topics in Algebra ranging from polynomial, rational, and exponential functions to conic sections. Trigonometry concepts such as Law of Sines and Cosines will be introduced. Students will then begin analytic geometry and calculus concepts such as limits, derivatives, and integrals. This class is important for any student planning to take a college algebra or college pre-calculus class.

Course Standards:

The following is a list of NJSLs that describe what students are expected to know and be able to do as a result of successfully completing this course. The following NJSLs are the basis of the assessment of student achievement. The learner will demonstrate mastery of:

Algebra

Arithmetic with Polynomials & Rational Expressions

1. Use polynomial identities to solve problems.
A.APR.B.2, A.APR.B.3

Creating Equations

2. Create equations that describe numbers or relationships.
A.CED.A.1, A.CED.A.3

Reasoning with Equations and Inequalities

3. Solve systems of equations.
A.REI.C.6, A.REI.C.7

Functions

Interpreting Functions

1. Interpret functions that arise in applications in terms of the context.
F.IF.B.4, F.IF.B.5
2. Analyze functions using different representations.
F.IF.C.7a, c, d

Linear, Quadratic, and Exponential Models

3. Construct and compare linear, quadratic, and exponential models and solve problems.
F.LE.A.3

Trigonometric Functions

4. Extend the domain of trigonometric functions using the unit circle.
F.TF.A.1, F.TF.A.2, F.TF.A.3, F.TF.A.4
5. Model periodic phenomena with trigonometric functions.

F.TF.B.7

6. Prove and apply trigonometric identities.

F.TF.C.8, F.TF.C.9

Geometry

Expressing Geometric Properties with Equations

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

G.GPE.A.2, G.GPE.A.3

Geometric Measurement and Division

2. Explain volume problems and use them to solve problems

G.GMD.A.2

Circles

3. Find arc lengths and areas of sectors of circles.

G.C.B.5

Similarity, Right Triangles, and Trigonometry

4. Define trigonometric ratios and solve problems involving right triangles

G.SRT.C.8

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them. *SMP1*
2. Reason abstractly and quantitatively. *SMP2*
3. Construct viable arguments and critique the reasoning of others. *SMP3*
4. Model with mathematics. *SMP4*
5. Use appropriate tools strategically. *SMP5*
6. Attend to precision. *SMP6*
7. Look for and make use of structure. *SMP7*
8. Look for and express regularity in repeated reasoning. *SMP8*

Scope and Sequence

Unit 1: Polynomial and Rational Functions (Marking Period 1)

In this Unit students will extend their understanding of inverse functions to functions with a degree higher than 1. Alongside this concept, students will factor and simplify rational expressions and functions to reveal domain restrictions and asymptotes. Students will become fluent in operating with rational and radical expressions and use the structure to model contextual situations. In this unit, students will also revisit the concept of an extraneous solution, first introduced in Algebra II, through the solution of radical and rational equations.

The unit begins with polynomial functions, where there is a focus on understanding the graphical and algebraic connections between polynomials and radical expressions, as well as fluently writing these expressions in different forms. Students delve deeper into rational equations and functions and identify characteristics such as the x-intercepts, y-intercepts,

asymptotes, and removable discontinuities based on the relationship between the degree of the numerator and denominator of the rational expression. Students will also connect these features with the transformation of the parent function of a rational function. Students solve rational and radical equations, identifying extraneous solutions, then modeling and solving equations in situations where rational and radical functions are necessary. Students will connect the domain algebraically with the context and interpret solutions.

Unit 2: Exponential and Logarithmic Functions (Marking Period 1)

Students have previously seen exponential functions in Algebra I. This unit builds off of that knowledge, revisiting exponential functions and including geometric sequences and series and continuous compounding situations. In the second part of the unit, students learn that the logarithm is the inverse of the exponent and to manipulate logarithmic expressions and equations. Finally, students apply their knowledge of logarithms to solve problems involving exponential modeling.

This unit is an excellent opportunity for students to practice mathematical modeling using exponential functions as models for situations in the world. Students will also look for and make use of structure as they manipulate logarithms and connect their knowledge of exponents to logarithms.

While this unit culminates the study of exponents and logarithms in the NJSLs, it leads to essential topics in calculus. Students preparing to take a calculus course should emphasize algebraic manipulation of exponential and logarithmic expressions to rewrite them in a variety of ways, including using properties of logarithms and analyzing functions to connect their graphs to equations and contextual situations.

Unit 3: Trigonometry (Marking Period 2)

High school math sequences typically include trigonometric functions as the final example of functions in the curriculum. Trigonometry offers an opportunity to synthesize knowledge of transformations and properties of other functions while offering a new perspective on functions through periodicity.

Trigonometry supports calculus, as the trigonometric functions have fascinating relationships through differentiation and integration and offer a great opportunity to practice calculus skills involving rate of change and accumulation.

While trigonometry is necessary for calculus, it also offers avenues to explore for their own sake. Students must connect geometric interpretations of sine and cosine, the unit circle, and the sine and cosine function and look at these three different mathematical structures as examples of the same underlying idea. Trigonometry also offers an opportunity to model periodic contexts in the world and to better understand phenomena around us.

Trigonometric Identities and Equations builds on the previous unit on trigonometric functions to expand students' knowledge of trigonometry. Students develop a foundation for calculus concepts by expanding their conception of trigonometric functions and looking at connections

between trigonometric functions. Reasoning flexibly about trigonometric functions and seeing that expressions that look different on the surface can actually act the same on certain domains sets the stage for a study of differentiation and integration, where periodic functions have many useful properties and act as useful tools to study calculus.

Students also apply algebraic techniques to trigonometry. This part of the unit reinforces algebraic skills while also helping students to better understand trigonometric functions graphically and through the unit circle. As students move more flexibly between representations of trigonometric functions, they develop skills in seeing structure in those functions and practice looking at mathematical objects from multiple perspectives and bringing prior knowledge to bear on a new context.

Unit 4: Systems of Equations and Inequalities (Marking Period 3)

Students will learn during this unit about how systems of equations can be solved with graphing, substitution or by eliminating a variable, and how many real life problems can be solved using systems of equations, to choose and solve a real world problem. Students will be given a list of real world scenarios to choose from ranging in difficulty. They will write a system of equations to represent the scenario and solve their systems using all three methods that they learned in this unit. Students will also reflect on which method they like the best and give details as to why they chose that method.

Unit 5: Conic Sections and Analytic Geometry (Marking Period 4)

Conic sections are used in a variety of construction and scientific applications such as bridge design, planetary and satellite orbits, mirrors, navigation and arches. The angle or direction you cut through a cone determines the type of conic you will get. Certain key points and axis are vital to graphing and using the conic sections to real world problems.

Unit 6: Introduction to Calculus (Marking Period 4)

Limits and Continuity, is an introduction to the calculus topics of limits, continuity, and it provides a foundation in the essential calculus skill of thinking and reasoning about the infinitely small and the infinitely large while also arguing logically based on definitions and theorems. Students should leave this unit confident working with piecewise functions, finding finite and infinite limits of various types of functions graphically and algebraically, and rigorously defining continuity.

This unit also offers a useful opportunity to review and deepen knowledge of various types of functions, and rational functions in particular offer a useful opportunity to apply knowledge of limits, analyze asymptotes and removable discontinuities, and think about end behavior, while all function types help students to apply function transformations in different contexts. These skills are essential foundational knowledge for calculus, and this unit should be tailored to the specific strengths and weaknesses of students to maximize the utility of that flexibility.

Since this unit serves as an introduction to Calculus, the lessons are aligned to the Learning Objectives and Essential Knowledge described in the College Board's AP Calculus AB and AP Calculus BC Course and Exam Description in the place of NJ Student Learning Standards.

Assessments

Evaluation of student achievement in this course will be based on the following:

- a. Tests & Quizzes
- b. Classwork
- c. Projects

Curriculum Resources

Instructional resources

Precalculus textbook and resources

Technology resources

<http://teacher.desmos.com>

www.illustrativemathematics.org

www.openmiddle.com

www.kutasoftware.com

Home and School Connection

The following are suggestions and/or resources that will help parents support their students:

- Khan Academy: www.khanacademy.com
- Teacher Google Classroom

