

Course Title:	Precalculus (H)
Grade(s):	10, 11, & 12

Course Description

This advanced mathematics course is designed to provide students with a strong foundation in algebra and trigonometry, preparing them for calculus and college algebra courses. There will be a comprehensive review of all the functions studied through Algebra 2: linear, quadratic, absolute value, polynomial, rational, exponential and logarithmic functions. The characteristics of these functions will be looked at both graphically and analytically and they will be used in modeling real-world problems. The six trigonometric functions will be introduced and studied closely both from a right triangle approach and from a circular approach. These functions will be looked at both graphically and analytically, and will be used in problem-solving. Additional formulas and identities associated with the trigonometric functions will be used to evaluate and solve trigonometric expressions and equations. The use of trigonometry in solving vector problems will also be studied in the context of motion problems and force diagrams from physics, and there will be a review of conic sections. Polar coordinates and graphs will be explored, as well as arithmetic and geometric sequences and series.

Honors Level (H)

Honors-level courses are designed to challenge the advanced learner. Students should expect to reach a deeper scope of skills than the academic class: a higher reading stamina, the motivation to revise work, critical thinking skills, and the propensity to finish complex tasks in a timely manner. Students in honors-level classes are expected to have a solid foundation of skills from previous courses, an ability to connect these skills to new learning, and the ability to apply them in problem-solving. Students taking an honors-level class have demonstrated the ability to take responsibility for their own learning and work fluidly both independently and collaboratively. These students should consistently aspire to achieve higher-level quality work through self-reflection and self-advocacy. These classes are recommended to students by teachers who have evaluated a student's past practice and achievement.

Course Units:

1. Functions and Their Graphs
2. Polynomial and Rational Functions
3. Exponential and Logarithmic Functions
4. Trigonometric Functions
5. Analytic Trigonometry
6. Additional Topics in Trigonometry
7. Conic Sections
8. Systems of Equations and Inequalities / Matrices

9. Sequences and Series
10. Introduction to Limits (If Time Permits - Honors)

Approved Curricular Materials/Textbook(s)

Precalculus 7th Edition by Robert Blitzer

Unit Title	Unit Description (Include Unit Objectives)	Unit Pacing
Unit 1: FUNCTIONS & THEIR GRAPHS	In this unit, students review basic functions and their graphs, linear functions and slopes, transformations of functions, composite functions, inverse functions and model with functions. Students will review basic functions, analyze and recognize the function algebraically and graphically, and perform basic operations with them. Unit Topics Include: - Analyzing Graphs of Functions - Average Rate of Change / Slope - Graphs of Functions - Transformations - Operations with Functions / Composition - Inverse Functions - Distance and Midpoint Formulas - Modeling with Functions	3.5 weeks (August - September)
Unit 2: POLYNOMIAL FUNCTIONS & RATIONAL FUNCTIONS	This unit includes a thorough study of polynomial and rational functions. We investigate algebraic methods for finding both real and complex number solutions of polynomial and rational functions and relate these methods and solutions to the graphical behavior of the functions. The unit culminates with using these functions to model real-world problems. Unit Topics Include: - Complex Numbers - Quadratic Function (Second-degree polynomials) - Polynomial Functions and Their Graphs - Dividing Polynomials - Remainder and Factor Theorems	3.5 weeks (September - October)

	• Zeros of Polynomial Functions • Rational Functions and Their Graphs • Polynomial and Rational Inequalities • Modeling Using Polynomial and Rational Functions	
Unit 3: EXPONENTIAL FUNCTIONS & LOGARITHMIC FUNCTIONS	This unit addresses the following domains: Seeing structure in expression, Creating equations, Reasoning with equations and inequalities. Students will: Interpret the structure of expressions; write expressions in equivalent forms to solve problems; create equations that describe numbers; and represent and solve equations graphically. During this unit of study, students will answer: What is the connection between exponential and logarithmic functions? What patterns of change are modeled by logarithmic functions as seen in real-world situations, and what tables, graphs, and function rules represent these situations? The study of exponential functions begins in Grade 8 and is a key component of the Algebra I curriculum. In Algebra II, students use their understanding of exponential functions with the definition of inverse functions to explore logarithms. The concept of function inverses is linked to the composition of functions. Introducing and using the composition of functions in this unit provides the opportunity to verify whether one function is the inverse of another. Recognizing the inverse relationship between exponential and logarithmic functions will help students to understand the definition of a logarithm; to know and be able to use the properties of logarithms; to make graphical connections between the two functions; and to solve exponential equations not only by using graphs and tables, but also by using the properties of logarithms. Connections to real-world situations are found in looking at situations that use a logarithmic scale to report values, such as the Richter scale, the pH scale and the measurement of sound intensity using a decibel scale. Unit Topics Include: • Graphing & Analyzing Exponential Functions • Logarithms • Graphing & Analyzing Logarithmic Functions • Properties of Logarithms	3 weeks - 4 weeks (October - November)

	• Exponential and Logarithmic Equations • Exponential Models - Growth & Decay	
Unit 4: CONIC SECTIONS	Apollonius (c. 250 - 175 BCE) was the first to study parabolas, circles, ellipses and hyperbolas extensively and connect them as various cross sections of a cone. The connections between algebra and geometry, known as analytic geometry, continued with the work of Descartes and Fermat in the 1600's, and were integral in the work of Galileo when he proved that projectiles followed parabolic paths, and in the work of Kepler, who studied planetary motion and determined that planets travelled in elliptical orbits. These geometric relationships continue to be used in many different fields. In this unit, we study the graphs and transformations of circles, parabolas, ellipses, and hyperbolas. We will look at the key characteristics of each of the conic sections. Students will use the conic sections to solve real-world problems. Unit Topic Include: • Parabolas • Circles • Ellipses • Hyperbolas	2 weeks - 3 weeks (November - December)
Unit 5: TRIGONOMETRIC FUNCTIONS	This unit focuses on the study of the six trigonometric functions and their graphs. The values and properties of the six trigonometric functions are determined and analyzed by both the right triangle method and by using the unit circle. The unit also focuses on using the six trigonometric functions in problem solving. Unit Topics Include: • Angles and Radian Measure • Trigonometric Functions: The Unit Circle • Right Triangle Trigonometry • Trigonometric Functions of any Angle • Graphs of Sine and Cosine Functions • Graphs of Other Trigonometric Functions • Inverse Trigonometric Functions	4 weeks - 5 weeks (December - January)

	• Applications of Trigonometric Functions	
Unit 6: ANALYTIC TRIGONOMETRY	This unit focuses on the patterns and relationships that connect the six trigonometric functions. These relationships help in simplifying complex expressions and in ultimately solving trigonometric equations. Unit Topics Include: • Verifying Trigonometric Identities • Sum and Difference Formulas • Double Angle and Half Angle Formulas • Trigonometric Equations	3 weeks (February)
Unit 7: ADDITIONAL TOPICS IN TRIGONOMETRY	This unit can be broken into three major topics of study: 1. The use of the Law of Sines and Law of Cosines to solve triangle problems that are not right triangles. 2. Investigating the properties of vectors (magnitude, direction, and components) and using vectors to analyze motion and forces. 3. Converting rectangular coordinates and equations to polar form, and graphing polar equations. Unit Topics Include: • The Law of Sines • The Law of Cosines • Vectors • Polar Coordinates • Graphs of Polar Equations	3 weeks (February - March)
Unit 8: SYSTEMS OF EQUATIONS AND INEQUALITIES / MATRICES	Many applications in science, engineering and business use systems of equations or inequalities in two or more variables as models. Several techniques (algebraic and graphical, and using matrices) are used to solve systems of linear and non-linear equations in this unit. The use of systems of equations is extended into three dimensions as we graph and analyze regions that are rotated to create three-dimensional shapes. Unit Topics Include:	4 weeks (March - April)

	• Systems of Linear Equations in Two Variables • Systems of Linear Equations in Three Variables • Partial Fractions • Systems of Non-linear Equations in Two Variables • Systems of Inequalities • Solving Linear Systems with Matrices	
Unit 9: SEQUENCES & SERIES (Time Permitting for Academic Level)	This unit addresses the following domains: Seeing structure in expression and interpreting functions. Students will write expressions in equivalent forms to solve problems, and examine the concept of a function and use function notation. Students have already had experience with arithmetic and geometric sequences. As they studied linear and exponential functions, these sequences appeared in tabular representations; this unit will allow students to formalize this knowledge. Students will learn to model problems involving sequential change, represent them using sigma notation, and analyze their model to solve problems. Understanding the differences and characteristics of arithmetic and geometric sequences will help students develop strategies to find sums of arithmetic and geometric series and develop formulas for these sums. Technology in the form of sequential modes of graphing calculators, CAS systems, and computer spreadsheets will provide additional resources for students to explore these topics. Unit Topics Include: • Sequences and Summation Notation • Arithmetic Sequences / Arithmetic Mean • Geometric Sequences and Series • Binomial Theorem	2 weeks (May - June)
Unit 10: INTRODUCTION TO LIMITS (Time Permitting)	In Precalculus, we have studied functions, graphs, and how quantities behave. Limits connect all of that knowledge and form the foundation of Calculus, especially for defining derivatives and integrals. The concept of a limit helps us understand what happens to a function's value as the input gets closer and closer to a particular number—even if the function never actually reaches that number. In many ways, limits allow us to zoom in on a function's behavior with infinite	2 weeks (May - June)

precision.

Even though the idea of limits may seem abstract at first, they provide a powerful way to describe change, motion, and growth in a precise mathematical way.

Learning limits will help you:

- Think about functions more deeply, especially near tricky points.
- Understand how mathematicians handle “approaching” values.
- Build the essential intuition needed for Calculus.

As you explore limits, you’ll discover that they are less about plugging in numbers and more about understanding behavior—what a function is trying to do as x moves toward a certain value. This makes limits one of the most important stepping stones into the world of Calculus.

Unit Topics Include:

- Introducing Calculus: Can Change Occur at an Instant?
- Defining Limits and Using Limit Notation
- Estimating Limit Values from Graphs
- Estimating Limit Values from Tables
- Determining Limits Using Algebraic Properties of Limits
- Determining Limits Using Algebraic Manipulation