

LIVE Online Math Pre-Calculus Scope and Sequence

The course is broken down into units. The units, and lessons that make up each unit, are below. **Note:** If there is a specific concept/technique that is not listed, please [contact us](#) to see if it is part of the course. Specific content is not always readily identifiable simply from the title of a lesson.

Unit 1: Algebra Review Part 1 – Exponents, Radicals, and Rational Expressions

Units 1 and 2 are meant to reconnect students to various concepts from Algebra. Most of the content will be related to Algebra II and will be presented in a “quick hitting” fashion. Students will be able to use the [Infinite Math™](#) practice system to refresh these skills as they go along. Unit 1 will re-connect students with various algebraic expressions and the methods for simplifying these expressions. This review is important for Pre-Calculus students.

Lesson 1: Exponent Laws and Fractional Exponents

Lesson 2: Simplifying Radicals (Square Roots, nth Roots, etc.)

Lesson 3: Complex Numbers

Lesson 4: Factoring

Lesson 5: Rational Expressions

Lesson 6: Solving Rational and Radical Equations

Unit 2: Algebra Review Part 2 – Equations and Inequalities

This is the second unit focused on reviewing Algebra skills and concepts. More difficult content is encountered in Unit 2, where the methods for solving quadratic equations comprise the bulk of the content. Several of the skills reviewed in this unit are applicable later in the course, as well as in higher levels of math.

Lesson 1: Linear Equations

Lesson 2: Inequalities

Lesson 3: Solving Systems of Equations

Lesson 4: Quadratic Equation Basics

Lesson 5: Solving Quadratic Equations

Lesson 6: Polynomial Long Division and Synthetic Division

Unit 3: Functions and Their Graphs

Exploring functions and their graphs primary focus of Unit 3. Some of the content may still be a review of Algebra II, but there is plenty of new content as well. Lessons 1-3 focus on various concepts related to functions. Going through piecewise functions in Lesson 1 helps students to understand how functions can work with each other to express a scenario that changes at various intervals – a great opportunity for the real life application of math. Much of this unit focused on techniques related to solving polynomial functions. While students should have encountered this content in Algebra II, it is likely that a thorough review will be needed, as this content can be quite difficult.

Lesson 1: Functions Concepts and Piecewise Functions

Lesson 2: Composition of Functions

Lesson 3: Inverse of Functions

Lesson 4: Polynomial Functions

Lesson 5: Find the Zeros of Polynomial Functions

Lesson 6: Polynomial and Rational Inequalities

Lesson 7: Families and Transformations of Graphs

Unit 4: Logarithmic and Exponential Functions

Logarithms provide a fertile ground for real life applications of math, and are the natural “cousin” of exponential functions. Common topics such as logarithmic properties, natural logarithms, Euler's Number, and solving exponential functions are all covered in full. The unit ends with a lesson on the applications of logarithms which focuses on how they can be used in real life. The graphing of exponential and logarithmic functions will be sprinkled throughout the unit and incorporated as their related concepts are introduced.

Lesson 1: Exponential Functions Introduction

Lesson 2: Exponential Functions with Base “e”

Lesson 3: Logarithms Introduction

Lesson 4: Properties of Logarithms and Common/Natural Logarithms

Lesson 5: Solving Exponential and Logarithmic Functions

Lesson 6: Special Applications of Logarithms

Unit 5: Conic Sections

Conic sections (sometimes referred to as “Analytic Geometry”) have a high visual appeal and can be applied in a variety of ways in the real world. Circles, parabolas, ellipses, and hyperbolas will all be explored in an in depth fashion. Parabolas in particular have several practical applications which will be explored. Students will initially learn why they are called “Conic Sections” and the unit wraps up with a dedicated lesson on applying what they've learned in a real life context.

Lesson 1: Introduction to Conic Section and Circles

Lesson 2: Parabolas

Lesson 3: Ellipses

Lesson 4: Hyperbolas

Lesson 5: Conic Sections Summary and Eccentricity

Lesson 6: Applications of Conic Sections

Unit 6: Fundamentals of Trigonometry

Unit 6 begins the first of four units related to the general study of Trigonometry. In Unit 6 familiar topics such as the Pythagorean Theorem and the traditional trigonometric ratios known as “sine”, “cosine” and “tangent” are introduced. From there, the concept of radians as a measure of angles is explored, and students move on to learning how to find exact values of trigonometric ratios of special angles. All of this culminates in the construction of the Unit Circle, which is a handy visual reference of many relevant trigonometric fundamentals that will be used in the future.

Lesson 1: The Pythagorean Theorem and Special Right Triangles

Lesson 2: Trigonometric Ratios

Lesson 3: Degree and Radian Measures of Angles

Lesson 4: Trigonometric Ratios for General Angles

Lesson 5: Special Angles and the Unit Circle

Unit 7: Trigonometric Functions and their Graphs

In Unit 7, students explore the graphic properties of various periodic functions. Students will begin with a basic function, $y = \sin x$, for example, and will learn to understand how various manipulations to the basic function affect the amplitude, period / frequency, phase shift, and vertical translations of the graph. This is done for all trigonometric functions. Additionally, students learn how combining two or more periodic functions (Sum or Product) will affect the

graph (Composition of Ordinates), and understand the reverse process (Harmonic Analysis) of writing a function for a given combined sinusoidal graph.

Lesson 1: Graphing Basic Trigonometric Functions

Lesson 2: Graphing Reciprocal Trigonometric Functions

Lesson 3: Transformations of Trigonometric Functions

Lesson 4: Inverse Trigonometric Functions

Lesson 5: Applications of Trigonometric Functions

Lesson 6: Composition of Ordinates and Harmonic Analysis (Part 1)

Unit 8: Trigonometric Identities

In Unit 8, students learn a variety of Trigonometric Identities. These give students the tools which are needed to manipulate, and eventually solve complex trigonometric equations. This is a crucial unit in the wider study of Trigonometry. Furthermore, examples of the composition of ordinates and harmonic analysis will be continued as it relates to the trigonometric identities learned earlier in this unit.

Lesson 1: Basic Trigonometric Identities

Lesson 2: Sum, Difference, and Co-Function Identities

Lesson 3: Double-Angle and Half-Angle Identities

Lesson 4: Product-Sum and Sum-Product Identities

Lesson 5: Solving Trigonometric Equations

Lesson 6: Composition of Ordinates and Harmonic Analysis (Part 2)

Unit 9: Triangle Trigonometry

Unit 9 is a short unit that concludes the formal study of Trigonometry by covering oblique triangles (those without a right angle). The Law of Sines and Law of Cosines will be derived and Heron's Law explored for its historical significance and the relationship it gives between side lengths and area of an oblique triangle. This unit concludes with a Trigonometry Project that serves as a comprehensive assignment for the four units focused on Trigonometry.

Lesson 1: Law of Sines

Lesson 2: Law of Cosines

Lesson 3: Heron's Law and the Area of a Triangle Using Trigonometry

Lesson 4: Triangle Applications

Unit 10: Polar Coordinate and Vectors

Up to this point, students have strictly been graphing in the rectangular coordinate system. In this unit, students will gain experience in the polar coordinate system and its advantages over the rectangular coordinate system for complicated equations. The unit will begin with a discussion of vectors, an important concept used in many fields of math and science. The polar coordinate system and polar equations will then be introduced. Following this, students will learn how to express complex numbers in polar form. Finally, students learn De Moivre's Theorem which allows students to take a complex number in polar form and find n th powers and n th roots of the number. The unit concludes with a discussion of parametric equations, a useful tool in mathematics and science.

Lesson 1: Introduction to Vectors

Lesson 2: Unit Vectors

Lesson 3: Polar Coordinates and Graphing Polar Equations

Lesson 4: Complex Numbers and Euler's Formula

Lesson 5: De Moivre's Theorem and the n th Root Theorem

Lesson 6: Polar Equations of Conic Sections

Lesson 7: Parametric Equations

Unit 11: Sequences, Series, Permutations, Combinations, and Probability

Unit 11 covers a variety of related content that could generally be classified as "Combinatorics". Sequences and series (both arithmetic and geometric) are studied in the first two lessons. Mathematical induction and the concept of proof will also be explored in this unit. A particularly useful series that can be proved with mathematical induction, the Binomial Series, will be introduced in Lesson 4. The second half of the unit is focused on the general study of permutations, combinations, and advanced applications of probability.

Lesson 1: Sequences

Lesson 2: Series

Lesson 3: Mathematical Induction

Lesson 4: Binomial Formula

Lesson 5: The Multiplication Principle and Permutations

Lesson 5: Combinations

Lesson 6: Advanced Probability and Binomial Probability

Unit 12: Matrices

Unit 12 is not a normal or complete unit. Various concepts and techniques related to matrices will be covered in this unit. Concepts will include matrix basics, multiplying matrices, the determinant of a matrix, identity and inverse matrices, and augmented matrices. These concepts will be covered as time permits.

Lesson 1: Introduction to Matrices

Lesson 2: Solving Systems of Equations with Matrices

Lesson 3: Determinants and Inverse Matrices

Bonus Lesson: Encryption Matrices