

# 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 “Rationals”

Units 1, 2, and 3 are meant to reconnect students to various concepts from Algebra. Most 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. It is likely that students will be able to “pre-test out of” some of the material in these units, since much of it will be review.

**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 Equations and Radical Equations

## Unit 2: Algebra Review Part 2 – Linear and Quadratic Equations

This is the second unit focused on reviewing Algebra skills and concepts. More difficult content is encountered in Unit 2, but it should still be review for most students. 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:** Compound Inequalities and Linear Inequalities

**Lesson 3:** Solving Systems of Equations by Substitution and Elimination (Linear and Non-Linear)

**Lesson 4:** Quadratics – General Concepts and Graphing

**Lesson 5:** Quadratics – Solving by Various Methods

**Lesson 6:** Polynomial Long Division and Synthetic Division

## Unit 3: Algebra Review Part 3 – Functions and Polynomials

Unit 3 is the final unit dedicated to reviewing Algebraic concepts. 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. The bulk of the unit though, is focused on techniques related to solving polynomial functions (cubic functions, quartic functions, etc.). 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 heavy.

**Lesson 1:** Functions Concepts and Piecewise Functions

**Lesson 2:** Composition of Functions

**Lesson 3:** Inverse of Functions

**Lesson 4:** Polynomial Functions, Their Roots, and The Remainder Theorem

**Lesson 5:** Solving Polynomial Functions

**Lesson 6:** Polynomial and Rational Inequalities

**Lesson 7:** Families of Graphs and Transformations of Graphs

## Unit 4: Logarithms 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 titled “Logarithmic Scales” which focuses on a couple real life uses of logarithms: Calculating loudness (in decibels) and the earthquake magnitude using the Richter Scale. 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 and Converting Logarithms to Exponents (and vice versa)

**Lesson 4:** Properties of Logarithms and Common/Natural Logarithms

**Lesson 5:** Solving Exponential and Logarithmic Functions

**Lesson 6:** Logarithmic Scales

## Unit 5: Conic Sections / Analytic Geometry

Conic sections (sometimes referred to as “Analytic Geometry”) have a high visual appeal and provide a much needed break at this point in the course from some of the earlier drier concepts. 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:** Conic Section Introduction and Circles

**Lesson 2:** Parabolas

**Lesson 3:** Ellipses

**Lesson 4:** Hyperbolas

**Lesson 5:** Eccentricity

**Lesson 6:** Real Life 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 “sin”, “cos” and “tan” are reviewed, as students have likely seen them before. From there the concept of radians as a measure of angles is introduced, 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:** Review of Pythagorean Theorem, 45-45-90 Triangles, and 30-60-90 Triangles

**Lesson 2:** Similar Triangles, Trigonometric Ratios (SOH-CAH-TOA), and Reciprocal Relationships

**Lesson 3:** Degree and Radian Measures of Angles

**Lesson 4:** General Angles and Real Number Domains

**Lesson 5:** Special Angles and the Unit Circle

**Lesson 6:** Rotations of Axes of Conic Sections

## Unit 7: Understanding Trigonometric Functions Graphically

In Unit 7, we explore the graphic properties of various periodic functions. Students will begin with a basic function,  $y = \sin x$ , for example, and 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:** Graphing Transformations of Trigonometric Functions

**Lesson 4:** Inverse Trigonometric Functions

**Lesson 5:** Applications of Trigonometric Functions

**Lesson 6:** Composition of Ordinates and Harmonic Analysis

## Unit 8: Trigonometric Identities

In Unit 8, we 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 shorter, but crucial unit in the wider study of Trigonometry.

**Lesson 1:** Basic Trigonometric Identities (Reciprocal, Quotient, Negatives, Pythagorean)

**Lesson 2:** Sum, Difference, and Cofunction Identities

**Lesson 3:** Double-Angle and Half-Angle Identities

**Lesson 4:** Product-Sum and Sum-Product Identities

**Lesson 5:** Solving Trigonometric Equations

## Unit 9: Triangle Trigonometry

Unit 9 concludes the formal study of Trigonometry by covering oblique triangles (those without a right angle). The Law of Sines and Law of Cosines define relationships between angles and sides of oblique triangles, while Heron's Law gives us the relationship between side lengths and area of an oblique triangle. This unit concludes with a thorough review and application of the entire 4-unit study of Trigonometry, as well as a final project.

**Lesson 1:** Law of Sines

**Lesson 2:** Law of Cosines

**Lesson 3:** Heron's Law

**Lesson 4:** General Trigonometry Review

**Lesson 5:** Culminating Trigonometry Project

## Unit 10: Polar Coordinate and Vectors

Unit 10 begins by applying certain Trigonometric concepts to understanding the vector, an important application used in many fields of math and science. Also based on Trigonometry, the polar coordinate system is then presented, along with attention to polar equations and their graphs. This is followed by learning 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 by having students delve deeper into Parametric Functions which were first introduced in Unit 7. They will primarily be focusing on converting between rectangular and polar forms of these functions.

**Lesson 1:** Vectors (Part 1)

**Lesson 2:** Vectors (Part 2)

**Lesson 3:** Polar Coordinates

**Lesson 4:** Complex Numbers: A Graphical Perspective

**Lesson 5:** De Moivre's Theorem

**Lesson 6:** Polar Equations of Conic Sections

**Lesson 7:** Applications of Parametric Functions

## 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. A particularly useful series, the Binomial Series, will be introduced in Lesson 3. The second half of the unit is focused on the general study of permutations, combinations, and advanced applications of probability.

**Lesson 1:** Arithmetic and Geometric Series

**Lesson 2:** Arithmetic and Geometric Sequences

**Lesson 3:** Binomial Formula

**Lesson 4:** Permutations / Combinations (Part 1)

**Lesson 5:** Permutations / Combinations (Part 2)

**Lesson 6:** Advanced Probability

## Unit 12: Matrices

Unit 12 is not a normal or complete unit. Various concepts and techniques related to matrices will be taught at various points in the course. Covered concepts will include matrices basics, using determinants, applying Cramer's Rule for solving systems of equations, identity and inverse matrices, and augmented matrices. These concepts will be covered as time permits.