

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. Finally, parametric functions are introduced on a simple level. This allows students to graph and understand Inverse Trigonometric Functions.

Lesson 1: Graphing Basic Periodic Functions

Lesson 2: Transformations of Periodic Functions

Lesson 3: Graphing Tangent, Cotangent, Secant, and Cosecant Functions

Lesson 4: Composition of Ordinates and Harmonic Analysis

Lesson 5: Introduction to Parametric Functions and Graphing Inverse Functions

Lesson 6: Inverse Trigonometric Functions

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.