Core-Plus Mathematics CCSS Edition

Course 1

Unit 1	**Patterns of Change** develops student ability to recognize and describe important patterns that relate quantitative variables, to use data tables, graphs, words, and symbols to represent the relationships, and to use reasoning and calculating tools to answer questions and solve problems. *Topics include* variables and functions, algebraic expressions and recurrence relations, coordinate graphs, data tables and spreadsheets, and equations and inequalities.
Unit 2	**Patterns in Data** develops student ability to summarize, represent, and interpret real-world data on a single count or measurement variable through the use of graphical displays of the distribution, measures of center, and measures of spread. *Topics include* distributions of data and their shapes, as displayed in dot plots, histograms, and box plots; measures of center (mean and median) and their properties; measures of spread including interquartile range and standard deviation and their properties; and percentiles and outliers.
Unit 3	**Linear Functions** develops student ability to recognize and represent linear relationships between variables and to use tables, graphs, and algebraic expressions for linear functions to solve problems in situations that involve constant rate of change or slope. *Topics include* linear functions, slope of a line, rate of change, modeling linear data patterns, solving linear equations and inequalities, equivalent linear expressions.
Unit 4	**Discrete Mathematical Modeling** develops student ability in modeling, reasoning, and problem solving as they use vertex-edge graphs to model and solve problems about networks, paths, and relations. *Topics include* vertex-edge graphs, mathematical modeling, optimization, algorithmic problem solving, using Euler paths to find efficient routes, using vertex coloring to avoid conflicts, and matrix representation of graphs to aid interpretation.
Unit 5	**Exponential Functions** develops student ability to recognize and represent exponential growth and decay patterns, to express those patterns in symbolic forms, to solve problems that involve exponential change, and to use properties of exponents to write expressions in equivalent forms. *Topics include* exponential growth and decay functions, data modeling, growth and decay rates, half-life and doubling time, compound interest, and properties of exponents.
Unit 6	**Patterns in Shape** develops student ability to visualize and describe two- and three-dimensional shapes, to represent them with drawings, to examine shape properties through both experimentation and careful reasoning, and to use those properties to solve problems. *Topics include* Triangle Inequality, congruence conditions for triangles, special quadrilaterals and quadrilateral linkages, Pythagorean Theorem, properties of polygons, tilings of the plane, properties of polyhedra, cylinders, cones, and the Platonic solids.
Unit 7	**Quadratic Functions** develops student ability to recognize and represent quadratic relations between variables using data tables, graphs, and symbolic formulas, to solve problems involving quadratic functions, and to express quadratic polynomials in equivalent factored and expanded forms. *Topics include* quadratic functions and their graphs, applications to projectile motion and economic problems, expanding and factoring quadratic expressions, and solving quadratic equations by the quadratic formula and calculator approximation.
Unit 8	**Patterns in Chance** develops student ability to solve problems involving chance by constructing sample spaces of equally-likely outcomes or geometric models and to use simulation to decide whether a model is consistent with the data. *Topics include* sample spaces, equally-likely outcomes, probability distributions, mutually exclusive (disjoint) events, Addition Rule, union, intersection, two-way frequency tables, simulation, random digits, discrete and continuous random variables, Law of Large Numbers, and geometric probability.

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Course 2

Unit 1	**Functions, Equations, and Systems** reviews and extends student ability to recognize, describe, and use functional relationships among quantitative variables, with special emphasis on relationships that involve two or more independent variables. *Topics include* direct and inverse variation and joint variation; power functions; linear equations in standard form; and systems of two linear equations with two variables, including solution by graphing, substitution, and elimination.
Unit 2	**Matrix Methods** develops student understanding of matrices and ability to use matrices to model and solve problems in a variety of real-world and mathematical settings. *Topics include* constructing and interpreting matrices, matrix addition, scalar multiplication, matrix multiplication, powers of matrices, inverse matrices, comparing algebraic properties of matrices to those of real numbers, and using matrices to solve systems of linear equations.
Unit 3	**Coordinate Methods** develops student understanding of coordinate methods for representing and analyzing properties of geometric shapes, for describing geometric change, and for producing animations. *Topics include* representing two-dimensional figures and modeling situations with coordinates, including computer-generated graphics; distance in the coordinate plane, midpoint of a segment, and slope; coordinate and matrix models of rigid transformations (translations, rotations, and line reflections), of size transformations, and of similarity transformations; animation effects.
Unit 4	**Regression and Correlation** develops student ability to describe how two quantitative variables on a scatterplot are related, including fitting a function to the data and the use of correlation to measure the strength of a linear association between the two variables. *Topics include* construct and interpret scatterplots; compute and interpret a linear model including slope and intercept, residuals, and the correlation coefficient; sum of squared errors; influential points; and distinguish between correlation and causation.
Unit 5	**Nonlinear Functions and Equations** introduces function notation, reviews and extends student ability to construct and reason with functions that model parabolic shapes and other quadratic relationships in science and economics, with special emphasis on formal symbolic reasoning methods, and introduces common logarithms and algebraic methods for solving exponential equations. *Topics include* formalization of function concept, notation, domain and range; factoring and expanding quadratic expressions, solving quadratic equations by factoring and the quadratic formula, applications to supply and demand, break-even analysis; common logarithms and solving exponential equations using base 10 logarithms.
Unit 6	**Modeling and Optimization** develops student ability in mathematical modeling, optimization, and problem solving, through study of vertex-edge graphs, as students model and solve problems about networks, paths, and circuits. *Topics include* mathematical modeling, optimization, algorithmic problem solving, and using minimum spanning trees, Hamilton paths, the Traveling Salesperson Problem, critical paths, and the PERT technique to solve network optimization problems.
Unit 7	**Trigonometric Methods** develops student understanding of trigonometric functions and the ability to use trigonometric methods to solve triangulation and indirect measurement problems. *Topics include* sine, cosine, and tangent functions of measures of angles in standard position in a coordinate plane and in a right triangle; indirect measurement; analysis of variable-sided triangle mechanisms; derivation and application of the Law of Sines and Law of Cosines.
Unit 8	**Probability Distributions** develops student understanding of independent events, conditional probability, and expected value and how to use them to interpret data and evaluate outcomes of decisions. *Topics include* two-way frequency tables, Multiplication Rule, independent and dependent events, conditional probability, probability distributions and their graphs, waiting-time (or geometric) distributions, and expected value for games of chance and for applications such as insurance.

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Course 3

Unit 1	**Reasoning and Proof** develops student understanding of formal reasoning in geometric, algebraic, and statistical contexts and of basic principles that underlie those reasoning strategies. *Topics include* inductive and deductive reasoning strategies; principles of logical reasoning—Affirming the Hypothesis and Chaining Implications; properties of line reflections; relation among angles formed by two intersecting lines or by two parallel lines and a transversal; rules for transforming algebraic expressions and equations; design of experiments; use of data from a randomized experiment to compare two treatments, sampling distribution constructed using simulation, randomization test, and statistical significance; inference from sample surveys, experiments, and observational studies and how randomization relates to each.
Unit 2	**Inequalities and Linear Programming** develops student ability to reason both algebraically and graphically to solve inequalities in one and two variables, introduces systems of inequalities in two variables, and develops a strategy for optimizing a linear function in two variables within a system of linear constraints on those variables. *Topics include* inequalities in one and two variables, number line graphs, interval notation, systems of linear inequalities, and linear programming.
Unit 3	**Similarity and Congruence** extends student understanding of similarity and congruence and their ability to use those relations to solve problems and to prove geometric assertions with and without the use of coordinates. *Topics include* connections between Law of Cosines, Law of Sines, and sufficient conditions for similarity and congruence of triangles; connections between transformations and sufficient conditions for congruence and similarity of triangles; centers of triangles, applications of similarity and congruence in real-world contexts; necessary and sufficient conditions for parallelograms, sufficient conditions for congruence of parallelograms, and midpoint connector theorems.
Unit 4	**Samples and Variation** develops student ability to use the normal distribution as a model of variation, introduces students to the binomial distribution and its use in making inferences about population parameters based on a random sample, and introduces students to the probability and statistical inference used in industry for statistical process control. *Topics include* normal distribution, standardized scores and estimating population percentages, binomial distributions (shape, expected value, standard deviation), normal approximation to a binomial distribution, odds, statistical process control, and the Central Limit Theorem.
Unit 5	**Polynomial and Rational Functions** extends student ability to represent and draw inferences about polynomial and rational functions using symbolic expressions and manipulations. *Topics include* definition and properties of polynomials, operations on polynomials; completing the square, proof of the quadratic formula, solving quadratic equations (including complex number solutions), vertex form of quadratic functions; definition and properties of rational functions, operations on rational expressions.
Unit 6	**Circles and Circular Functions** develops student understanding of properties of special lines, segments, angles, and arcs in circles and the ability to use those properties to solve problems; develops student understanding of circular functions and the ability to use those functions to model periodic change; and extends student ability to reason deductively in geometric settings. *Topics include* properties of chords, tangent lines, and central and inscribed angles and their intercepted arcs; linear and angular velocity; radian measure of angles; and circular functions as models of periodic change.
Unit 7	**Recursion and Iteration** extends student ability to model, analyze, and solve problems in situations involving sequential and recursive change. *Topics include* iteration and recursion as tools to model and solve problems about sequential change in real-world settings, including compound interest and population growth; arithmetic, geometric, and other sequences together with their connections to linear, exponential, and polynomial functions; arithmetic and geometric series; finite differences; linear and nonlinear recurrence relations; and function iteration, including graphical iteration and fixed points.
Unit 8	**Inverse Functions** develops student understanding of inverses of functions with a focus on logarithmic functions and their use in modeling and analyzing problem situations and data patterns. *Topics include* inverses of functions; logarithmic functions and their relation to exponential functions, properties of logarithms, equation solving with logarithms; and inverse trigonometric functions and their applications to solving trigonometric equations.

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Course 4—Preparation for Calculus

Unit 1	**Families of Functions** extends student understanding of linear, exponential, quadratic, power, and circular functions to model data patterns whose graphs are transformations of basic patterns; and develops understanding of operations on functions useful in representing and reasoning about quantitative relationships. *Topics include* linear, exponential, quadratic, power, and trigonometric functions; data modeling; translation, reflection, and stretching of graphs; and addition, subtraction, multiplication, division, and composition of functions.
Unit 2	**Vectors and Motion** develops student understanding of two-dimensional vectors and their use in modeling linear, circular, and other nonlinear motion. *Topics include* concept of vector as a mathematical object used to model situations defined by magnitude and direction; equality of vectors, scalar multiples, opposite vectors, sum and difference vectors, dot product of two vectors, position vectors and coordinates; and parametric equations for motion along a line and for motion of projectiles and objects in circular and elliptical orbits.
Unit 3	**Algebraic Functions and Equations** reviews and extends student understanding of properties of polynomial and rational functions and skills in manipulating algebraic expressions and solving polynomial and rational equations, and develops student understanding of complex number representations and operations. *Topics include* polynomials, polynomial division, factor and remainder theorems, operations on complex numbers, representation of complex numbers as vectors, solution of polynomial equations, rational function graphs and asymptotes, and solution of rational equations and equations involving radical expressions.
Unit 4	**Trigonometric Functions and Equations** extends student understanding of, and ability to reason with, trigonometric functions to prove or disprove potential trigonometric identities and to solve trigonometric equations; develops student ability to geometrically represent complex numbers and their operations and to find powers and roots of complex numbers expressed in trigonometric form. *Topics include* fundamental trigonometric identities, sum and difference identities, double-angle identities; periodic solutions of trigonometric equations; definitions of secant, cosecant, and cotangent functions; absolute value and trigonometric form of complex numbers, De Moivre's Theorem, and roots of complex numbers.
Unit 5	**Exponential Functions, Logarithms, and Data Modeling** extends student understanding of exponential and logarithmic functions to the case of natural exponential and logarithmic functions, solution of exponential growth and decay problems, and use of logarithms for linearization and modeling of data patterns. *Topics include* exponential functions with rules in the form $f(x) = Ae^{kx}$, natural logarithm function, linearizing bivariate data and fitting models using log and log-log transformations.
Unit 6	**Surfaces and Cross Sections** extends student ability to visualize and represent three-dimensional shapes using contours, cross sections, and reliefs, and to visualize and represent surfaces and conic sections defined by algebraic equations. *Topics include* using contours to represent three-dimensional surfaces and developing contour maps from data; sketching surfaces from sets of cross sections; conics as planar sections of right circular cones and as loci of points in a plane; three-dimensional rectangular coordinate system; sketching surfaces using traces, intercepts and cross sections derived from algebraically-defined surfaces; and surfaces of revolution and cylindrical surfaces.
Unit 7	**Concepts of Calculus** develops student understanding of fundamental calculus ideas through explorations in a variety of applied problem contexts and their representations in function tables and graphs. *Topics include* instantaneous rates of change, linear approximation, area under a curve, and applications to problems in physics, business, and other disciplines.
Unit 8	**Counting Methods and Induction** extends student ability to count systematically and solve enumeration problems in a variety of real-world and mathematical settings, and develops understanding of, and ability to carry out, proofs by mathematical induction and by use of the Least Number Principle. *Topics include* systematic listing, counting trees, the Multiplication Principle of Counting, the Addition Principle of Counting, combinations, permutations, selections with repetition; the Binomial Theorem, Pascal's triangle, combinatorial reasoning; the General Multiplication Rule for Probability; proof by mathematical induction; and arguments using proof by contradiction and the Least Number Principle.