Course Title: AP Calculus
Content Area: Mathematics
Grade Level: 11/12

Scope and Sequence

Course Name: AP Calculus	**Course Text:** Houghton Mifflin Company, Calculus with Analytic Geometry 8th Edition

Course Introduction: AP Calculus is the final course offered for those students pursuing careers in the science, physics, math, and engineering fields.

Units of Study:	Student Learning Objectives:	PA Common Core Standards:	Length	Assessment	Scaffolding	Materials
Preparation for Calculus						
• Graphs and Models • Linear Models and Rates of Change • Functions and their Graphs • Fitting Models to Data	Students will be able to • Sketch graphs of equations • Find intercepts of a graph • Test for symmetry • Find points of intersection of two graphs • Interpret mathematical models for real-life data • Find the slope of a line • Write the equation of a line • Interpret slope as a ratio or rate • Sketch the graph of a linear equation • Write equations of parallel and perpendicular lines • Use function notation • Find domain and range • Sketch graphs • Identify transformations • Classify functions • Recognize combinations of functions • Fit a linear model to a real-life data set • Fit a quadratic model to a real-life data set	**Standards** 2.11.11.A, B, C	**2 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard

	• Fit a trigonometric model to a real-life data set					
Limits and Their Properties						
• A Preview of Calculus • Finding Limits Graphically and Numerically • Evaluating Limits Analytically • Continuity and One-Sided Limits • Infinite Limits	Students will be able to • Understand what calculus is and how it relates to pre-calculus • Understand the basic calculus topic of the ***tangent line*** • Understand the basic calculus problem of ***area*** • Evaluate a limit numerically and graphically • Learn how a limit can fail to exist • Use the formal definition of a limit • Evaluate a limit using properties of limits • Develop and use a strategy for finding limits • Evaluate a limit using dividing and rationalizing techniques • Evaluate a limit using the Squeeze Theorem • Determine continuity at a point and on an open interval • Determine one-sided limits and continuity on a closed interval • Use properties of continuity • Understand and use the ***Intermediate Value Theorem*** • Determine infinite limits from the left and from the right • Find and sketch the vertical asymptotes of the graph of a function	**Standards** 2.11.11.A, B, C	**3 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard

Differentiation						
• The Derivative and the Tangent Line Problem • Basic Differentiation Rules and Rates of Change • Product and Quotient Rules and Higher-Order Derivatives • The Chain Rule • Implicit Differentiation • Related Rates	Students will be able to • Find the slope of the tangent line to a curve at a point • Use the limit definition to find the derivative of a function • Understand the relationship between differentiability and continuity • Find derivatives using the constant rule • Find derivatives using the power rule • Find derivatives using the constant multiple rule • Find derivatives using the sum and difference rules • Find derivatives of the sine and cosine function • Use derivatives to find ***rates of change*** • Find derivatives using the Product Rule • Find derivatives using the Quotient Rule • Find derivatives of the remaining Trigonometric functions • Find higher-order derivatives • Find derivatives of composite functions using the Chain Rule • Find derivatives using the General Power Rule • Simplify derivatives • Find derivatives of trigonometric functions using the Chain Rule • Distinguish between implicit and explicit functions • Find derivatives using Implicit Differentiation • Find a related rate • Use related rates to solve real-life problems	**<u>Standards</u>** 2.11.11.A, B, C	**4 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard

Applications of Differentiation						
• Extrema on an Interval • Rolle's Theorem and the Mean Value Theorem (AP Only) • Increasing and Decreasing Functions and the First Derivative Test • Concavity and the Second Derivative Test • Limits at Infinity • A Summary of Curve Sketching • Optimization Problems (AP Only) • Differentials	Students will be able to • Define extrema of a function on an interval • Define relative extrema of a function on an open interval • Find extrema on a closed interval • Understand and use Rolle's Theorem • Understand and use the Mean Value Theorem • Define increasing and decreasing functions • Determine intervals on which a function is increasing or decreasing • Apply the First Derivative Test to find relative extrema of a function • Determine intervals on which a function is concave upward and downward • Find points of inflection of the graph of a function • Apply the Second Derivative Test to find relative extrema of a function • Determine finite limits at infinity • Determine horizontal asymptotes of the graph of a function • Determine infinite limits at infinity • Analyze and sketch graphs of functions • Solve applied maximum and minimum problems • Understand the concept of tangent line approximation • Compare the value of the differential dy with the actual change in y or Δy • Estimate error using a differential • Find and calculate the differential of a function	**Standards** 2.11.11.A, B, C	**4 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard

	• Approximate function values using differentials					
Integration						
• Antiderivatives and Indefinite Integration • Area • Riemann Sums and Definite Integrals • The Fundamental Theorem of Calculus • Integration by Substitution • Numerical Integration	Students will be able to • Write the general solution of a differential equation • Use indefinite integral notation for antiderivatives • Use basic integration rules to find antiderivatives • Find a particular solution of a differential equation • Use sigma notation to write and evaluate a sum • Understand the concept of area • Approximate the area of a plane region • Find the exact area of a plane region using limits • Understand the definition of a Riemann Sum • Evaluate a definite integral using limits • Evaluate a definite integral using properties of definite integrals • Evaluate a definite integral using the FTC (Part 1) • Understand and use the Second FTC (Part 2) • Understand and use the Mean Value Theorem for integrals • Find the average value of a function over a closed interval • Use pattern recognition to find an indefinite integral • Use a change of variable (substitution) to find an indefinite integral • Use the general power rule for integration	**Standards** 2.11.11.A, B, C	**4 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard

	• Use a change of variable to find definite integrals • Evaluate definite integrals involving even or odd functions • Review the Midpoint Rule and approximate definite integrals • Approximate definite integrals with the Trapezoidal Rule					
Logarithmic, Exponential, and Other Transcendental Functions						
• The Natural Logarithmic Function: Differentiation • The Natural Logarithmic Function: integration • Inverse Functions • Exponential Functions: Differentiation and Integration • Bases Other than e and Application (AP Only) • Inverse Trigonometric functions: Differentiation (AP Only) • Inverse Trigonometric functions: Integration (AP Only)	Students will be able to • Develop and use properties of the natural logarithmic function • Understand the definition of e • Find derivatives of functions involving the natural logarithmic function • Use the Log Rule for Integration to integrate rational functions • Integrate trigonometric functions • Verify that one function is the inverse of another • Determine if a function has an inverse • Find derivatives of inverse functions • Develop properties of the natural exponential function • Differentiate and Integrate natural exponential functions • Define exponential functions with bases other than e • Differentiate and integrate exponential functions with bases other than e • Use exponential functions to model problems • Develop properties of three inverse trig functions • Differentiate an inverse trig function • Review the basic differentiation rules • Integrate functions whose antiderivatives involve inverse trig functions	**Standards** 2.11.11.A, B, C	**4 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard

	• Use completing the square to integrate a function • Review and compare basic integration rules					
Differential Equations						
• Slope Fields • Differential Equations: Growth and Decay • Separation of Variables	Students will be able to • Use initial conditions to find particular solutions of differential equations • Use slope fields to approximate solutions of differential equations • Use ***separation of variables*** to solve simple differential equations • Use exponential functions (revisit) to model growth and decay problems • Recognize and solve DE's that can be solved by separation of variables	**Standards** 2.11.11.A, B, C	**3 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard
Applications of Integration						
• Area of a region Between Two Curves • Volume: the Disk Method	Students will be able to • Find the area of a region between two curves using integration • Find the area of a region between intersecting curves using integration • Find the volume of a solid of revolution using the disk and washer methods • Find the volume of a solid with known cross sections	**Standards** 2.11.11.A, B, C	**3 weeks**	Teacher created assessments	Re-take tests/quizzes below 55% or according to SDI's	Text, Calculators, Guided notes, Review sheets, Blackboard