

Calculus Curriculum Map

The objective of this course is to provide students with a clear understanding of calculus as these topics are investigated and assessed numerically, graphically, analytically, and verbally. Students are expected to use a graphing calculator, but not be totally dependent upon it, as they learn the outlined topics. Students will work through the below outlined topics of study. Each year the course will vary in the amount of material covered as the course is designed for those students not prepared for the rigorous pace of Advanced Placement Calculus. The outline below encompasses all Advanced Placement Objectives.

The textbook for this course is *Calculus Graphical, Numeric, Algebraic AP Edition* by Finney, Demana, Waits, and Kennedy © 2007.

Course Outline

Prerequisites for Calculus (Chapter 1)

- 1.1 Lines
- 1.2 Functions and Graphs
- 1.3 Exponential Functions
- 1.4 Parametric Equations
- 1.5 Functions and Logarithms
- 1.6 Trigonometric Functions

Limits and Continuity (Chapter 2)

- 2.1 Rate of Change and Limits
- 2.2 Limits Involving Infinity
- 2.3 Continuity
- 2.4 Rates of Change and Tangent Lines

Derivatives (Chapter 3)

- 3.1 Derivative of a Function
- 3.2 Differentiability
- 3.3 Rules for Differentiation
- 3.4 Velocity and Other Rates of Change
- 3.5 Derivatives of Trigonometric Functions
- 3.6 Chain Rule
- 3.7 Implicit Differentiation
- 3.8 Derivatives of Inverse Trigonometric Functions
- 3.9 Derivatives of Exponential and Logarithmic Functions

Applications of Derivatives (Chapter 4)

- 4.1 Extreme Values of Functions
- 4.2 Mean Values Theorem
- 4.3 Connecting f' , and f'' with the Graph of f
- 4.4 Modeling and Optimization
- 4.5 Linearization and Newton's Method
- 4.6 Related Rates

The Definite Integral (Chapter 5)

- 5.1 Estimating with Finite Sums
- 5.2 Definite Integrals
- 5.3 Definite Integrals and Antiderivatives
- 5.4 Fundamental Theorem of Calculus
- 5.5 Trapezoidal Rule

Differential Equations and Mathematical Modeling (Chapter 6)

- 6.1 Slope Fields and Euler's Method
- 6.2 Antidifferentiation by Substitution
- 6.4 Exponential Growth and Decay

Applications of the Definite Integrals (Chapter 7)

- 7.1 Integral as a Net Change
- 7.2 Areas in the Plane
- 7.3 Volumes

Correlation to AP Course Objectives

(Provided by *Calculus Graphical, Numeric, Algebraic AP Edition* by Finney, Demana, Waits, and Kennedy © 2007, pp. xviii-xx.)

<i>Topic</i>	<i>Section</i>
<i>Functions, Graphs, and Limits</i>	
* Analysis of graphs	1.2 – 1.6
* Limits of Functions (including one-sided limits)	
- An intuitive understanding of the limiting process	2.1 – 2.2
- Calculating limits using algebra	2.1 – 2.2
- Estimating limits from graphs or tables of data	2.1 – 2.2
* Asymptotic and unbounded behavior	

- Understanding asymptotes in terms of graphical behavior	2.2
- Describing asymptotic behavior in terms of limits involving infinity	2.2
- Comparing relative magnitudes of functions and their rates of change	2.2, 2.4
*Continuity as a property of functions	
- An intuitive understanding of continuity	2.3
- Understanding continuity in terms of limits	2.3
- Geometric understanding of graphs of continuous functions	2.3, 4.1 – 4.3
Derivatives	
* Concept of the derivative	
- Derivative presented graphically, numerically, and analytically	2.4 – 2.5
- Derivative interpreted as an instantaneous rate of change	2.4
- Derivative defined as the limit of the difference quotient	2.4 – 3.1
- Relationship between differentiability and continuity	3.2
* Derivative at a point	
- Slope of a curve at a point	2.4
- Tangent line to a curve at a point and local linear approximation	2.4 – 2.5
- Instantaneous rate of change as the limit of the average rate of change	2.4, 3.4
- Approximate rate of change from graphs and tables of values	2.4, 3.4
*Derivative as a function	
- Corresponding characteristics of a graphs of f and f'	3.1, 4.3
- Relationship between the concavity of f and the sign of f''	4.1, 4.3
- The Mean Value Theorem and its geometric consequence	4.2
- Equations involving derivative. Verbal descriptions are translated into equations involving derivatives and vice versa	3.4, 3.5, 4.6, 6.4
*Second Derivatives	
- Corresponding characteristics of graphs of f , f' , and f''	4.3
- Relationship between the concavity of f and the sign of f''	4.3
- Points of inflection as places where concavity changes	4.3
*Applications of derivative	
- Analysis of curves, including the notions of monotonicity, and concavity	4.1 – 4.3
- Optimization, both absolute (global) and relative (local) extrema	4.3 – 4.4
- Modeling rates of change, including related rate problems	4.6
- Use of implicit differentiation to find the derivative of an inverse function	3.7
- Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration.	3.4
- Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations	6.1
*Computation of derivatives	
- Knowledge of derivatives of basic functions, including power,	3.3, 3.5

<ul style="list-style-type: none"> exponential, logarithmic, trigonometric, and inverse trigonometric functions - Basic rules for the derivative of sums, products, and quotients of functions - Chain rule and implicit differentiation 	<p>3.3</p> <p>3.6 – 3.7</p>
Integrals	
* Interpretations and properties of definite integrals	
<ul style="list-style-type: none"> - Definite integral as a limit of Riemann sums 	5.1 – 5.2
Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the closed interval [a,b]	5.1, 5.4
of $\int f'(x)dx = f(b) - f(a)$	
<ul style="list-style-type: none"> - Basic properties of definite integrals 	5.2 – 5.3
* Applications of integrals	
<ul style="list-style-type: none"> - Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations...students should be able to adapt their knowledge and techniques. Emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral.... Specific applications should include using the integral of a rate of change to give accumulated change, finding the area of a region, the volume of a solid with known cross sections, the average value of a function, and the distance traveled by a particle along a line. 	5.4 – 5.5, 6.4, 7.1 – 7.3
* Fundamental Theorem of Calculus	
<ul style="list-style-type: none"> - Use of the Fundamental Theorem to evaluate definite integrals 	5.4
<ul style="list-style-type: none"> - Use of the Fundamental theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so derived. 	5.4, 6.1
* Techniques of Integration	
<ul style="list-style-type: none"> - Antiderivatives following directly from derivatives of basic functions 	4.2 6.1 – 6.2
<ul style="list-style-type: none"> - Antiderivatives by substitution of variables (including change of limits for definite integrals) 	6.2
<ul style="list-style-type: none"> - Finding specific antiderivatives using initial conditions, including applications to motion along a line 	6.1 – 7.1
<ul style="list-style-type: none"> - Solving separable differential equations and using them in modeling in particular, studying the equations $y' = ky$ and exponential growth 	6.4
<ul style="list-style-type: none"> - Use of Riemann and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values 	5.2, 5.5

