

AP Calculus AB

Syllabus

Course Overview

The primary goal of this Advanced Placement Calculus class is to provide students with a strong mathematical background of differential and integral calculus. By having a strong calculus backbone, students will be able to apply concepts to real situations and appreciate the power of mathematics. Secondary goals of the class are preparing students to use technology as an aid in solving problems and to be successful on the AP Exam at the end of the course. By meeting all of these goals, students should understand that we study calculus because our world is always changing and calculus is the mathematics of changing environments and that calculus is a powerful tool in solving complex problems in mathematics, science, and engineering.

Course Outline/Timeline

Unit 1: Calculus Preparation (4 days)

Review of Algebra/Precalculus topics:

1. Piecewise Defined Functions
2. Even/Odd Functions
3. Slopes/Equations of Lines
4. Solving Linear, Quadratic, Trigonometric Equations
5. Domain/Range
6. Simplifying Rational Expressions

Unit 2: Limits and Their Properties (11 days)

Covers sections 1.2-1.5 in textbook

1. Finding limits graphically and numerically
2. Finding limits analytically
3. Properties of limits
4. Continuity on open and closed intervals
5. Intermediate Value Theorem
6. Limits at infinity

Unit 3: Differentiation (34 days)

Covers sections 2.1-2.6 in textbook

1. Limit definition of the derivative of a function
2. Finding the equation of a tangent line
3. Differentiability
4. Basic Differentiation Rules
 - a. Constant
 - b. Power
 - c. Sum/Difference
 - d. Sine/Cosine
5. Derivatives involving motion (velocity and acceleration)

6. Product Rule
7. Quotient Rule
8. Higher Ordered Derivatives
9. Chain Rule
10. Implicit Differentiation
11. Related Rates

Unit 4: Applications of Differentiation (24 days)

Covers sections 3.1-3.7 of textbook

1. Extrema on an interval
 - a. Open vs. Closed intervals
2. Extreme Value Theorem
3. Critical Values
4. Mean Value Theorem
5. Rates of Change
 - a. Instantaneous vs. Average
6. Intervals of Increasing/Decreasing Functions
7. First Derivative Test
8. Finding Relative Extrema Values
9. Definition of Concavity
10. Finding Intervals of Concavity
11. Finding Inflection Points
12. Limits at Infinity
13. Definition of Horizontal Asymptotes
14. Graphing using Derivative Tests
15. Solving Optimization Problems

Unit 5: Integration (27 days)

Covers sections 4.1-4.6 in textbook

1. Antiderivatives
2. Solving Differential Equations
 - a. General vs. Particular Solutions
3. Basic Integration Rules
4. Finding Area—Riemann Sums
5. Finding Area—Number of Rectangles goes to Infinity
6. Definition of the Definite Integral
7. Properties of Definite Integrals
8. 1st Part of the Fundamental Theorem of Calculus
9. Applications of the Definite Integral
10. Finding Average Value of a Function
11. Definite Integrals as Area Accumulator Functions
12. 2nd Part of the Fundamental Theorem of Calculus
13. Integration using Substitution
14. Numerical Integration
 - a. Trapezoid Rule
 - b. Simpson's Rule

Unit 6: Logarithmic and Exponential Functions (22 days)

Covers Sections 5.1-5.7 and 6.1-6.3 in textbook

1. Differentiation of the Natural Logarithmic Function
2. Integration of the Natural Logarithmic Function
3. Derivatives of Inverse Functions
4. Differentiation of Exponential Functions
5. Integration of Exponential Functions
6. Derivatives of Bases other than e
7. Applications of Logarithmic and Exponential Functions
8. Solving Growth and Decay Problems
 - a. Newton's Law of Cooling
9. Using Separation of Variables to Solve Differential Equations
10. Slope Fields
11. The Logistic Equation
12. Differentiation of Inverse Trigonometric Functions
13. Integration of Inverse Trigonometric Functions

Unit 7: Applications of Integration (9 days)

Covers sections 7.1 and 7.2 in textbook

1. Finding Area between two curves
2. Finding Volume using Disk Method
3. Finding Volume using Washer Method
4. Finding Volume using Known Cross-Sections

Unit 8: Review for AP Exam (15 days)

Teaching Strategies

I use several different strategies throughout the year to help solidify the learning and understanding of calculus. From the beginning of the year, algebraic techniques are reviewed and emphasized. During the year, cumulative review is used every two to three weeks. The cumulative review consists of AP problems from previous years. These are assigned approximately twice a month. Some of these reviews are individual efforts and some are assigned in cooperative groups. Students are graded on mathematical correctness, neatness, and clearly written justifications. Students are also expected to be able to verbally explain their mathematical processes.

Technology is used on a daily basis. A Smartboard is used for instructional purposes, for displaying *TI InterActive!*, for viewing applicable internet sites, and for demonstration applets. I use *TI Smart-View* for demonstration, exploration, and giving students a "picture" of what is being discussed. Students use graphing calculators to explore various calculus topics graphically and numerically.

As often as possible, I encourage students to discover calculus topics instead of just receiving information from the teacher. We do this through large group discussions, small group discussions, use of technology, and activities/labs.

Student Evaluation

Students are evaluated through the following:

- Daily homework (with written justifications)
- AP Practice Problems
- Quizzes
- Tests
- Labs/Group Work
- Board Work (with verbal explanations)
- Semester Exam

Primary Textbook

Larson, Ron, Bruce H. Edwards, and Robert P. Hostetler. *Calculus of a Single Variable*. Eighth Edition. Boston: Houghton Mifflin, 2006

Supplemental Materials and Activities

Student conceptual learning is supported through the following activities:

- The table feature of graphing calculators are used to numerically find limits (including one-sided limits)
- The zoom feature of graphing calculators is used to investigate local linearity and differentiability of functions
- By estimating the slopes of a sine curve at several points and plotting these slopes on the calculators to obtain a graph of the derivative of sine, students arrive at the conclusion that the derivative of sine is cosine. This process is also used to “find” the derivatives of the cosine, natural log, and exponential functions.
- A Riemann Sum calculator program is used to show students how the area becomes more accurate as the number of rectangles increases. By using the program, we can use large numbers of rectangles (50, 100, 500).
- To explore slope fields, students are divided into groups and assigned different points on a 10 x 10 grid. Given a differential equation of $dy/dx = -x/y$, each group is responsible for plotting the slope (using a short line segment) at their assigned coordinates. After all groups have completed their “slope field”, students can then see that we have formed a family of circles, which leads to a discussion making a connection between an equation and its differential equation.
- Physics worksheets are used to make connections between position, velocity, and acceleration.
- A “spread of disease” simulation is done in class to explore logistic curves.
- A lab involving Torricelli’s law to reinforce solving differential equations.
- A mathematician study is done after the AP Exam. Students are required to research the mathematician of their choice. They must present the information that they acquire in a PowerPoint presentation. Through this activity, students learn to appreciate the history and beauty of Mathematics.