AP Calculus AB Syllabus

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Course Overview

My main objective in teaching AP Calculus AB is to develop the students' understanding of the concepts of calculus by proving an experience with its methods and applications. This course will emphasize a multi-representational approach to calculus, with concepts, results, and problems being expressed numerically, algebraically, graphically, and verbally. This course is intended to be challenging and demanding. Broad concepts and widely applicable methods will be emphasized. Although manipulation and computational competence are important outcomes, these will not be the core of this course. Technology will be used regularly to reinforce the relationships among the multiple representations of functions, to confirm written work, implement experimentation, and to assist in interpreting results. This course is unifying theme of derivatives, integrals, limits, approximation, and applications and modeling. Students will develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.
(Excerpt from Philosophy and Goal in the AP Calculus Teacher's Guide – Mark Howell, Gonzaga College High School, Washington, D.C.)

Course Planner

The primary textbook I use is Ron Larson and Bruce H. Edward's *Calculus of a Single Variable*, 9th edition.

School starts on August 18th, so we have about 75 class days before Spring Break, not including field trips, early release, holidays, and school cancelations. The following breakdown presents the approximate time we allow for each section in the textbook covered for the number of days of the course and a description of the topics covered. Day lengths are subject to change.

Chapter	Sections Covered	Topics Discussed	Timeline
Limits and Their Properties	1.1	A Preview of Calculus	1 day
	1.2	Finding Limits Graphically and Numerically	2 days
	1.3	Evaluating Limits Analytically	2 days
	1.4	Continuity and One-Sided Limits	2 days
	1.5	Infinite Limits	2 days
	Section Project	Graphs and Limits of Trigonometric Functions	
	3.5	Limits at Infinity	2 days
Differentiation	2.1	The Derivative and the Tangent Line Problem	
	2.2	Basic Differentiation Rules and Rate of Change	3 days

	2.3	Product and Quotient Rules and Higher-Order Derivatives	2 days
	2.4	The Chain Rule	3 days
	2.5	Implicit Differentiation	2 days
	Section Project	Optical Illusions	
	2.6	Related Rates	3 days
Applications of Differentiation	3.1	Extrema on an Interval	2 days
	3.2	Rolle's Theorem and the Mean Value Theorem	2 days
	3.3	Increasing and Decreasing Functions and the First Derivative Test	2 days
	Section Project	Rainbows	
	3.4	Concavity and the Second Derivative Test	2 days
	3.6	A Summary of Curve Sketching	1 day
	3.7	Optimization Problems	3 days
	Section Project	Connecticut River	
	3.8*	Newton's Method	2 days
	3.9	Differentials	2 days
Integration	4.1	Antiderivatives and Indefinite Integration	3 days
	4.2	Area	2 days
	4.3	Riemann Sums and Definite Integrals	3 days
	4.4	The Fundamental Theorem of Calculus	2 days
	Section Project	Demonstrating the Fundamental Theorem	
	4.5	Integration by Substitution	2 days
	4.6	Numerical Integration	1 day
Logarithmic, Exponential, and Other Transcendental Functions	5.1	The Natural Logarithmic Function: Differentiation	2 days
	5.2*	The Natural Logarithmic Function: Integration	2 days
	5.3*	Inverse Functions	2 days
	5.4	Exponential Differentiation and Integration	2 days
	5.5	Bases Other Than *e* and Applications	3 days
	Section Project	Using Graphing Utilities to Estimate Slope	
	5.6	Inverse Trigonometric Functions: Differentiation	3 days
	5.7*	Inverse Trigonometric Function: Integration	1 day
	Section Project	St. Louis Arch	
Differential Equations	6.1	Slope Fields and Euler's Method	2 days
	6.2	Differential Equations: Growth and Decay	2 days
	6.3	Separation of Variables and Logistic Equation	2 days
	6.4*	First-Order Linear Differential Equations	3 days
	Section Project	Weight Loss	
Applications of Integration	7.1	Area of a Region Between Two Curves	2 days
	7.2	Volume: The Disk Method	3 days
	7.3*	Volume: The Shell Method	3 days
	Section Project	Saturn	
	AFTER AP EXAM		
Integration	8.1*	Basic Integration Rules	2 days

Techniques, L'Hôpital's Rule, and Improper Integrals	8.2*	Integration by Parts	3 days
	8.3*	Trigonometric Integrals	3 days
	Section Project	Power Lines	
	8.4*	Trigonometric Substitution	3 days
	8.5*	Partial Fractions	3 days
	8.6*	Integration by Tables and Other Integration Techniques	2 days
	8.7*	Indeterminate Forms and L'Hôpital's Rule	1 day
	8.8*	Improper Integrals	3 days

*not corresponding sections for AP Calculus AB

After the AP Exam

We will cover topics from Chapter 8 and other sections from previous chapters of our primary textbook; these topics are not part of the Calculus AB syllabus. Quizzes and tests will be given on this material.

Teaching Strategies

Summer Expectations. I believe that the most important element of my calculus course is coming to class every day prepared to work. To demonstrate this commitment to hard work, students are required to complete a summer assignment before entering my class. Since the first chapter of our calculus text is a review of our Pre-Calculus text, students are able to work through this chapter on their own. A PDF of the prerequisite chapter was posted on Edmodo for the students to review over the summer.

Prerequisite Test. During the first full day of class, the students will take a multiple-choice test based on these previously learned topics. If a student scores less than a 70% they will be required to go to tutoring after school, at least once each week, for the first month to address their weaknesses. This test will not be calculated into their GPA, unless they score a 70% or better, with which the students will be awarded with a one-grade A.

Primary Textbook. Our textbook includes, but is not limited to, exploration examples, numerous practice exercises, concept writing, capstone questions, technology and multi-subject connections, section projects, review exercises, and test prep questions.

Problem Solving. Throughout the course, the students will work individually, in pairs, small groups, and as a class to complete in-class assignments, assessments, and projects. These pairs and groups may be chosen by the student, teacher, or at random. Because participation and observation is beneficial to student learning, students are allowed to come up to the board to contribute to a problem or initiate a discussion with the class based on said problem.

Graphing Calculator. Many application problems rely heavily on the use of a graphing calculator. The calculator helps students develop a visual understanding of the material they would not otherwise be able to comprehend. Students will be using TI-84 Plus Silver Color (or higher) calculators and computer programs during class and for homework assignments to explore and discover calculus concepts. Since the AP Exam is half calculator and half non-calculator, it is important for students to have practice working problems both ways. Techniques needed to use the calculator more efficiently will also be discussed.

Rule of Four. Topics will be presented in a variety of ways: numerically, algebraically, graphically, and verbally. Most of the problems in the primary textbook are written with an analytical representation, so problems will be supplemented giving graphical or tabular data and students will be asked for verbal or written explanations to communicate their reasoning in words.

Justification of Answers. Students will justify their answers on homework, quizzes, and tests, preferably using sentences. The "Commentary on the Instructions for the Free-Response Section of the AP Calculus Exams" on AP Central is very helpful in showing examples of correct justification

Homework. Students will have homework assigned after each class. It is very important that students do their homework each night so they can gain the maximum benefit from the homework discussion that occurs the next day in class.

Section Projects. Students will be assigned section projects after every 3-5 sections in a chapter. The students will work in pairs (or individually if they choose) chosen by the teacher, students, or randomly selected, to complete the project. The students will have two nights, or one weekend, to type their responses using complete sentences. Using a Gmail account and Google Drive, these can be completed entirely online. The Google document tracks the activity of both members and can be edited by either one at any time of day. Graphs and can be hand-drawn on the printed document. Google Documents has most of the same features as Microsoft Word, such as tables, drawings, symbols, and equations.

AP Review. Students will begin each day with a "Problem of the Day," which will assess them on material that was previously covered. They will be presented with a multiple-choice question or a partial free-response question where they will show work to find an answer or explain the meaning of an answer which they answer using R.A.R.E. (Restate, Answer, Reasons, Evidence/Explanation). The responses will be graded on using the scoring guideline that is used during AP Calculus Reading sessions. The goal is to get all of the required material completed by Spring Break so the rest of the weeks will be dedicated to review for the AP Calculus AB exam, scheduled May 5th. During the review period, students will be given AP Exams from previous years and the problems will be discussed. This will help students develop a better idea of the "real" exam and not stress the night before.

Final Project, Peer Teaching. Students will divide into groups of two or three members each and be allowed to choose one of the topics covered after the AP Exam on a first-come, first-serve basis. They must collectively study and subsequently teach their topic to the class, getting approval for their lesson plan before their presentation date. Each individual will be required to present at least five minutes on a section of the topic via describing a concept, showing an example, etc. Students are evaluated by peers and the teacher.

Student Evaluation

Quarter grades are computed using problem-of-the-day entries (1 a week), homework (1), projects (3), quizzes (4), and tests (6). Homework is awarded a score based on completion and correctness. Quizzes will be given once a section or a few sections are completed. Projects are given after the completion of a few sections. Tests will be given once a chapter is completed. Quizzes and tests will include both multiple choice and free-response questions with calculator and non-calculator sections.

Quarter grades are assigned as follows:

90—100 = A

80—89 = B

70—79 = C

60—69 = D

Below 60 = failing

Teacher Resources

Larson, R., Edward & B.H. (2010). *Calculus of a single variable* (9^{th} ed.). Belmont, CA: Brooks/Cole Cengage Learning.

Kelley, W.M. (2006). *The humungous book of calculus problems* New York, NY: Penguin Group.