AP Calculus BC Syllabus

Course Overview:

This course is designed to meet all requirements for Advanced Placement Calculus BC. The major topics we will cover are limits, continuity, derivatives, integrals, the Fundamental Theorem of Calculus, and series. We will work together to investigate, analyze, and explain content through graphing, making tables, and using words. We will look at applications involving physics to ensure understanding.

Technology Requirement:

A graphing calculator is required every day for this course. A TI-84 Plus CE will be used in class for demonstrations. Students should have their own calculators every day in order to ensure comfort, but extra calculators will be provided if necessary.

Classroom Expectations:

It is important that students be active participants at all times. This means coming to class with the required materials, having homework complete, and being willing to share ideas and thoughts with the class. Sometimes we will work in partners and on some occasions in small groups. This is to allow for meaningful conversions and to maximize learning. We will often work on practice AP questions where as a class, we will discuss and critique our answers. Students should be reading the text on their own as well and coming for extra help with any questions they may have. Small study groups are also encouraged.

Homework:

Homework is assigned every night. We will go over questions as a class. Homework will be checked every day, sometimes for completion and sometimes for correctness. Students are also expected to read the sections in the textbook before we cover the content in class.

Textbook:

Calculus (AP® Edition). Ron Larson, Bruce H. Edwards. 10th ed. National Geographic/Cengage Learning.

Additional Resources:

The class Canvas page will have access to practice websites as well as notes and homework.
We will also be using WebAssign, which is an online resource linked to the textbook.

Course Outline:

Limits and Continuity: Chapter 1

- 1.1 A Preview of Calculus
- 1.2 Finding Limits Graphically and Numerically
- 1.3 Evaluating Limits Analytically
- 1.4 Continuity and One Sided Limits
- 1.5 Infinite Limits
- 1.6 Limits at Infinity

Sample Activities:

- Students will use graphing calculators to see graphs and tables to identify limit values and whether or not they exist. The graphing calculator is used extensively to explore what happens to average rates of change as the distance to a fixed endpoint gets smaller. The graphing calculator is used to explore obvious limits and not-so-obvious limits (to see it's visual limitations). Students will share their discoveries with each other in presentation format.

- Students will work on identifying vertical, horizontal, and slant asymptotes of various functions. There will be discussion on how these features affect a limit and continuity. We will use the relationship between horizontal asymptotes and limits at infinity. Students will work together to discover this on their own or in small groups. Graphing calculators can be used at times to help in the process.

- Students explore the derivative function using the limit definition of the derivative at a point. For several points, students compute the difference quotient algebraically using the definition and use their graphing calculators to evaluate the limits and interpret their results in terms of the definition to decide if the derivative does or does not exist at each point. The original function and its derivative values are graphed and shared and critiqued with a partner.

Differentiation: Chapter 2

- 2.1 The Derivative and the Tangent Line Problem
- 2.2 Basic Differentiation Rules and Rates of Change
- 2.3 Product and Quotient Rules and Higher Order Derivatives
- 2.4 The Chain Rule
- 2.5 Implicit Differentiation
- 2.6 Derivatives of Inverse Functions
- 2.7 Related Rates

Sample Activities:

- Students will investigate differentiation rules like power rule and discover the rules on their own. Students will use product and quotient rules to differentiate trigonometric functions.

- Students will investigate cusps in a discussion about differentiability and continuity. They will be able to determine whether differentiability implies continuity and vice versa. The use of the graphing calculator will come in handy in determining whether the functions are continuous and differentiable.

- Students will participate in Derivatives Around the World. Multiple problems are posted around the room with the answers located underneath other problems. Students must identify the derivative and move around the room until they have finished all the problems posted. The problems contain complex, multi-step differentiation involving chain rule, product rule, quotient rule, and trig derivatives. This activity helps students to determine when they need to use each differentiation rule and that sometimes they have choices in determining which rule is easiest to use. Students will work in partners for this activity to allow for discussion of this process.

Applications of Differentiation: Chapter 3

- 3.1 Extrema on an Interval
- 3.2 Rolle's Theorem and the Mean Value Theorem
- 3.3 Increasing and Decreasing Functions and the First Derivative Test
- 3.4 Concavity and the Second Derivative Test
- 3.5 A Summary of Curve Sketching
- 3.6 Optimization Problems
- 3.7 Differentials

Sample Activities:

- Students will use the graphing calculator to investigate *f ' (x)* and determine key features of *f (x)* like increasing/decreasing, local maximums and minimums, points of inflection, and concavity. Once they have determined all key features, students will give a partner this information to see if they can produce the graph of *f (x)*. Students will then share their graphs and discuss differences.

Integration: Chapter 4

- 4.1 Antiderivatives
- 4.2 Area
- 4.3 Riemann Sums and Definite Integrals
- 4.4 The Fundamental Theorem of Calculus: Parts I and II
- 4.5 Integration by Substitution
- 4.6 The Natural Log Function: Integration
- 4.7 Inverse Trig Functions: Integration

Sample Activities:

- Students will complete a Trapezoid Rule project. This will allow them to see how to perfect their approximations. Through investigation they will determine that increasing the number of trapezoids will allow their approximations to get closer to the exact area under the curve. This will then be linked to integration. Students will work in groups to complete this task.

- Students will do a Riemann Sum with MVT points (to demonstrate what's coming in the proof of the FTOC) using the graphing calculator and note the accuracy as compared to the definite integral.

- Students will use the graphing calculator to graph functions like $\int_0^x cost\ dt$ to see how the second part of the fundamental theorem of calculus works first-hand.

- Students write an expression for an approximation of the area between the horizontal axis and the graph of $f(x)$ for a particular function given as a formula on a specified interval as a left, right, and midpoint Riemann sum using n subdivisions. The students will use Symbolab with slider to calculate Riemann Sums. The software allows for left, right, and midpoint sums. The slider increases the number of partitions to explore precision. Finally, students write limits of their Riemann suns as n goes to infinity, then identify each as a definite integral, and use the Fundamental Theorem of Calculus to evaluate the integral.

Applications of Integration: Chapter 6

- 6.1 Area of a Region Between Two Curves
- 6.2 Volume: The Disc and Washer Methods
- 6.3 Volume: The Shell Method
- 6.4 Arc Length and Surfaces of Revolution

Sample Activities:

- Students are expected to justify that their "optimum solution" is, in fact, optimum. That is, they must verify that a critical value satisfies the desired result.

- Graphing calculator is used to support the results of the calculus in the case of optimization, both visually and through the use of minimum and maximum functions. However, these are not allowed to replace the analytic location and verifications.

Integration Techniques, L'Hopital's Rule, and Improper Integrals: Chapter 7

- 7.1 Basic Integration Rules
- 7.2 Integration by Parts
- 7.3 Trigonometric Integrals
- 7.4 Trigonometric Substitution
- 7.5 Partial Fractions
- 7.6 Integration by Tables and Other Integration Techniques
- 7.7 Intermediate Forms and L'Hopital's Rule
- 7.8 Improper Integrals

Sample Activities:

- Students work in groups on a worksheet involving integration by parts problems. The goal is to determine how to choose the function for u. Students write the first step of two potential solutions choosing a different function for u each time. At the end, students are given the five basic function types (logarithmic, inverse trig, algebraic, trig, and exponential) and asked to put them in descending order for the best options for u. Groups will then explain and justify their answers to the class. Discrepancies will be discussed and an overall solution will be reached.

Infinite Series: Chapter 8

- 8.1 Sequences
- 8.2 Series and Convergence
- 8.3 The Integral Test and p-Series
- 8.4 Comparisonxs of Series
- 8.5 Alternating Series
- 8.6 The Ratio and Root Tests
- 8.7 Taylor Polynomials and Approximations
- 8.8 Power Series
- 8.9 Representation of Functions by Power Series
- 8.10 Taylor and Maclaurin Series

Sample Activities:

- Geometric Series Around the World is played in groups of two. Geometric series are posted around the room with various sums listed underneath other problems. Students must find the sums of the geometric series to move their way around the room. Students will work in pairs to allow for discussion.

Parametric Equations, Polar Coordinates, and Vectors: Chapter 9

- 9.1 Conics and Calculus
- 9.2 Plane Curves and Parametric Equations
- 9.3 Parametric Equations and Calculus
- 9.4 Polar Coordinates and Polar Graphs
- 9.5 Area and Arc Length in Polar Coordinates
- 9.6 Vectors in the Plane
- 9.7 Vector-Valued Functions
- 9.8 Velocity and Acceleration

Sample Activities:

- Students will create interesting, detailed polar graphs. They will create a poster to display their graphs. They will also be required to calculate area and arc length involved in their graphs. Students will then present their work to the class. Students will write a written report, using complete sentences, to explain how they calculated both the area and the arc length for their graphs.

Differential Equations: Chapter 5

- 5.1 Slope Fields
- 5.2 Growth and Decay
- 5.3 Separation of Variables
- 5.4 The Logistic Equation

Sample Activities:

- On the graphing calculator, fnInt(y, x, a, b) is used to investigate population growth via two equivalent differential equations, one in time and one in population, to motivate the need for an antiderivative if 1/x.

- Students discuss how different starting values result in very different results, and are required to consider what factors might cause certain features in slope fields representing real world situations (populations of a single species in a given area or predator/prey models, for example)

AP Review:

We will practice and prepare for the AP test throughout the year. We will use old AP exam questions in order to prepare for the style of question. Each chapter review will contain AP style practice questions. The take home sections of each chapter test will also contain AP style questions. At three times throughout the school year, students will practice taking entire timed sections of practice AP tests. Students are encouraged to do this on their own as well.