

AP Calculus AB

Prerequisites: Algebra I, Geometry, Algebra II, and Pre-Calculus

Calculus allows us to study the mathematics of change. The study of calculus is divided into three big ideas: 1) Limits, 2) Derivatives, and 3) Integrals and the Fundamental Theorem of Calculus. We will investigate and analyze course topics verbally, analytically, graphically, and numerically with an emphasis on a conceptual understanding of calculus. The curriculum for this course is defined by The College Board and designed to meet the Advanced Placement curricular requirements for Calculus AB. Successful completion of this curriculum should prepare you for the AP Calculus AB exam.

Course Expectations

Calculus concepts are studied analytically, graphically, and numerically. Students are expected to use correct mathematics representations as well as correct vocabulary when explaining work. Students will be required to explain and/or justify their solutions orally during class demonstrations. In addition, all assignments will require students to include justifications of their work in multiple representations, including symbolical and graphical representations that accompany complete written sentences explaining their processes and solutions.

Technology Usage

A classroom set of TI-Nspire CX calculators are available during class when we are in person. Students are encouraged to purchase their own graphing calculator but calculators will be available for checkout. I am currently working on a plan to have calculators sent home with you along with charging chords. Students are required to master four calculator uses: finding zeros of a function, sketching graphs in a specific window, using numerical derivatives and finding definite integrals. The graphing calculator is also useful in studying limits, local linearity, and slope fields. The calculator allows students to “discover” concepts and relationships important to calculus. Along with each student’s personal calculator, the TI-Navigator will be used to demonstrate concepts using the graphing calculator to the class as a whole. Geometer’s Sketchpad will also be used to explore, discover, and reinforce the concepts of calculus in whole-class demonstrations as well as activities in the computer lab.

Textbook

Larson, Hostetler, and Edwards. *Calculus – Single Variable*. Eighth Edition. Boston and New York: Houghton Mifflin Company, 2006

Supplemental Resources

Promoting Calculus Concepts for All: A Hands-On Approach to Calculus. Dr. Nina Girard; University of Pittsburgh and Dr. Mike Long; Shippensburg University. NCTM Conference, 2009

Work Smarter Not Harder – Calculus Labs for TI-82 and TI-83/84. Sam Gough, Mary Ann Gore, Debbie Crawford and Jill Gough. Venture Publishing, 2005. (modified for TI-Nspire CX)

TI-Nspire Activities: <http://education.ti.com/en/timathnspired/us/home>

AP Central – Questions from past exams, Modules, resources

Course Outline

Throughout the course, students will solve a variety of multiple-choice and free response questions over limits, derivatives, and integrals from past AP exams. Students will be required to justify their answers using calculus-based concepts. Students will be required to present their reasoning orally at the board or in written justifications several times throughout the school year. Students will also be instructed to include clearly written justifications in complete sentences for their solutions.

Some of the listed projects/assignments may be changed in the virtual setting.

BIG IDEA 1: Limits

Unit 1: Limits – 3 weeks

- 1.2 Finding Limits Graphically and Numerically
- 1.3 Evaluating Limits Analytically
- 1.4 Continuity and One-Sided Limits
- 1.5 Infinite Limits
- 3.5 Limits at Infinity

Sample Activities:

- TI-Nspire Limit Exploration: Using the TI-Nspire CX, students, with a partner, will investigate the various views of how a function behaves as the input approaches a particular value. Students will develop an intuitive understanding of the limit process. Students will also estimate limits from graphs and tables of values.
- The Intermediate Value Theorem Exploration: With partners, students will explore the conditions for the hypothesis and conclusion for IVT by examining various graphs. During the activity, particular attention will be paid to continuous and discontinuous functions. Students will develop the Intermediate Value Theorem in their own words.
- Limit War: This game uses a set of 24 cards with limits expressed analytically. For each round, players find the limits of their card and announce the answer to their group. The player with the highest result (i.e., infinity, finite values in descending order, negative infinity, and does not exist) wins the cards. Decks are created so that each student receives an equal number of cards with special values in a three-person game. The student with the most cards at the end of the allotted time wins. In the cut-throat version, players can steal if their opponent incorrectly evaluates their limit.

BIG IDEA 2: Derivatives

Unit 2: The Derivative – 5 weeks

- 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 Related Rates
- 8.7 Indeterminate Forms and L'Hopital's Rule

Sample Activities:

- “Continuity and Differentiability” TI-Nspire Activity: Students will determine when a function is continuous or differentiable.
- Shoebox Project: Students will design their own related rates problem and develop a design with a moving part in their shoebox including the solution. The activity requires students to solve an equation analytically and write a coherent explanation of their thinking. During class, students will participate in a Gallery Walk where students will solve each other problems. If mistakes are discovered in the solution, students will work together to develop the correct answer.

Unit 3: Applications of Differentiation – 6 weeks

- 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 Limits at Infinity
- 3.6 A Summary of Curve Sketching
- 3.7 Optimization Problems
- 3.9 Differentials

Sample Activities:

- “Critical Points and Local Extrema” TI-Nspire Activity: The lesson involves visualizing connections between the critical points and local extrema. Students will zoom in on function graphs at different types of critical points to determine the slope of the tangent line. Students will use the First Derivative Test as a means to identify local maximum and minimum.
- “ f, f', f'' ” Activity: Students will sketch a graph of f given the formulas for f' and f'' . Exchanging papers with a partner, students will compare their answers. Together students will come to agreement.

BIG IDEA 3: Integrals and the Fundamental Theorem of Calculus

Unit 4: Integration – 5 weeks

- 4.1 Antiderivatives and Indefinite Integration
- 4.2 Area
- 4.3 Riemann Sums and Definite Integrals
- 4.4 The Fundamental Theorem of Calculus (Part 1 and 2)
- 4.5 Integration by Substitution
- 4.6 Numerical Integration

Sample Activities:

- “Riemann Sums” TI-Nspire Activity: The lesson involves Riemann Sums used to estimate the area of a plane region. Students will conjecture about each estimate as the number of rectangles increases and in relation to certain characteristics of the function. Students will also 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 activity superimposes rectangular areas on the graph of $f(x)$ showing the sum value for left, right, and midpoint sums. The slider increases the number of partitions to explore precision. Students will conjecture about other geometric figures that may produce better estimates. In a later lesson, student will write limits of their Riemann sums as n goes to infinity, identify each as a definite integral, and use the Fundamental Theorem of Calculus to evaluate the integral.

- Definite Integrals Activity: Students in groups must calculate definite integrals using the definition, tables, and graphs. Real-life examples are included, and students must clearly interpret the integral's meaning using the proper units. Students will discuss their answers.

Unit 5: Logarithm and Exponential Functions – 4 weeks (BIG IDEA 2 included)

- 5.1 The Natural Logarithmic Function: Differentiation
- 5.2 The Natural Logarithmic Function: Integration
- 5.3 Inverse Functions
- 5.4 Exponential Functions: Differentiation and Integration
- 5.5 Bases Other than e and Applications
- 5.6 Inverse Trigonometric Functions: Differentiation
- 5.7 Inverse Trigonometric Functions: Integration

Sample Activities:

- Free-Response Cafe' Conversation Activity: Using previous AP free-response questions, students, in groups, will begin solving the problem in a shorten time period. When time is called, the groups will transition to a different problem. The group must check the solution of the previous group, make corrections if needed, and then continue to solve the problem. Groups will rotate among 4-5 problems. Students will present their last problem to the entire class.

Unit 6: Differential Equations and Application of Integration – 3 weeks

- 6.1 Slope Fields and Euler's Method
- 6.2 Differential Equations: Growth and Decay
- 6.3 Separation of Variables
- 7.1 Area of a Region Between Two Curves
- 7.2 Volume: The Disk Method
- 7.3 Volume: The Shell Method

Sample Activities:

- Differential Equations Activity: Students will be given a collection of application problems involving initial conditions. Students, with partners, will solve the problems. After the groups have completed the activity, the class will discuss and analyze various techniques each group used in solving the problems.
- Growth and Decay Activity: Students are given a variety of growth and decay word problems where the rate of change of the dependent variable is proportional to the same variable (i.e. population growth, radioactive decay, etc.). Students are asked to translate the problem situation into a differential equation using proper notation. Students show the steps in solving

the differential equation, continuing to use proper notation for each step (i.e. keeping or removing the absolute value).

- “How Sweet It Is” Activity: Students will sketch the region given and determine the general shape of the region (shape of a food or candy). Using plastic knives, students will determine whether to slice with respect to x or y . Using their real world model as a reference, students will determine the volume.

Unit 7: Review – 4 weeks

- Mock Exam
- Free-response Writing Journal – Using Free-Response Questions from previous exams, students will solve the problem. Students will self-assess their answers using the scoring guide. Students will submit reflective journal entries. Students will reflect on their personal strengths and weaknesses based on their results.
- Practice with sample MC questions – TI-Nspire Navigator will be used to formatively assess student progress.

Grading

Semester grade: 40% First 9 weeks

40% Second 9 weeks

20% Final

Nine weeks grade: 50% Tests

30% Quizzes/Projects

20% Daily Formative Assessments (Flashbacks, homework, class work)

AP Calculus

2020 - 2021 Syllabus

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I. Class Expectations – In Person and Virtual

- **All school rules will be enforced.**
- Plagiarism will not be tolerated.
- Each student is expected to respect others in the classroom and treat everyone as he/she would like to be treated including peers, guests, and me, as the teacher.
- Attendance is critical, but if a student is absent it is their responsibility to ask for the make-up work before or after class. They will have the number of days they were absent plus one extra to turn in the make-up work unless you discuss an alternative with me.
- I expect all students to keep up with their work in my class. That means it must be turned in on time – **I will not accept late work.** All assignments are due at the beginning of class unless otherwise stated by me. If an assignment is not turned in on time it will result in a zero.

II. Virtual Expectations

- Check google classroom daily for assignments and announcements.
- Students must attend scheduled class Zoom meetings. Below is the current schedule:

AP Calculus AB: 2 nd period: 8:25 – 9:25 AM				
Monday	Tuesday	Wednesday	Thursday	Friday
Independent or Video Lesson, RTI if needed	Zoom Meeting Link found in google classroom	Independent or Video Lesson, RTI if needed	Zoom Meeting Link found in google classroom	Office Hours – time for extra assistance or questions

Schedule is subject to change.

- While online, make sure your surroundings are appropriate. You may use an appropriate screen background if you do not want to show your household. This also includes your dress. You must have the video on so I can see your engagement during the lesson along with any visual struggle cues. Microphone should be turned off until commenting during the lesson.
- Important to show all of your work on assignments. I encourage you to work together but the work should be your own. When taking a photo of your work, please check the photo to make sure I can read everything before submitting.
- Along with google classroom, I will be the AP classroom through College Board. You will need to join the class with the code **Y3RMMZ**. Be sure to use your “official” name when joining. Assignments will be assigned through this platform but I will make an announcement in google classroom as well.
- If you are struggling or have an issue, please email me as soon as possible. I cannot help you if I don't know there is a problem. This not only includes when you are struggling with the work, but also if you are sick or have an emergency.

III. TI-Nspire CX Calculators

We will be using TI-Nspire CX calculators. I **HIGHLY** recommend students have their own graphing calculators to familiarize themselves with this technology. I am currently working on a plan to have calculators sent home with you along with charging chords. Scientific calculators are NOT permitted.

IV. AP Exam/Weighted Grades

According to District policy, students must take the AP exam in order to receive the weighted credit. The AP Calculus AB exam will be given on Tuesday, May 4 at 8:00 am. The deadline set by AP College Board for students to decide to take an AP exam is November 6th. This date will also be the last day money can be collected. Mrs. Mullennex will be setting up dates to take care of this, and I will send that information out as soon as possible.

Grading scale: 90 -100 – A
 80 - 89 – B
 70 - 79 – C
 60 - 69 – D
 59 and below – F

Quarter Dates: Q1: August 26 – October 30
 Q2: November 4 – January 15
 Q3: January 19 – March 22
 Q4: March 23 – June 1

V. Communication/Conferences:

Students and parents have access to Infinite Campus Portal and I strongly recommend you view this on a regular basis. My grades are updated weekly/daily in order to keep everyone informed. Please do not ask for extra credit as I do not give extra credit to individual students. Conferences can be scheduled as needed. If there are ever any concerns or questions, please do not hesitate to contact me.

VI. Question Board – In Person Instruction Only

I always encourage questions, but I realize it can sometimes be intimidating in front of your peers. The Question Board is in my room to allow students to write questions to me without fear. These questions can include problems from homework, quizzes, or tests but it is not limited to this. To encourage more questions, students will have the opportunity to drop their lowest homework assignment. Students can do this by asking 5 questions during the 9 weeks. To receive credit for this, students will have to write their name (it can be done on the back) and will only receive 2 credits a week.

VII. Test Corrections – In Person Instruction Only

After each exam, students will be given 1 week (or shorter if at the end of a grading period) to make test corrections. Students must convince me that they understand how to do the problem and correct it completely. This may involve written explanations. Students will receive ½ credit for corrected answers added to their exam grade. This opportunity is a privilege and if abused may be ended.

VIII. Mock Exam/Study Sessions

- Saturday or after school study sessions – dates will be announced at a later date
- Mock Exam – Friday, April 2, 2021

I also reserve the right to make changes to the syllabus should the need arise. I am looking forward to a wonderful year.