RHINEBECK CENTRAL SCHOOL DISTRICT
PRIORITIZED CURRICULUM
AP CALCULUS AB

COURSE OVERVIEW

We cover everything in the Calculus AB topic outline as it appears in the AP® Calculus Course Description, including integration by parts, L'Hospital's Rule and trigonometric substitutions. The primary textbook is Calculus: Graphical, Numerical, Algebraic, 3rd edition by Ross L. Finney, Franklin D. Demana, Bert K. Waits and Daniel Kennedy. The two main objectives of this course are that the students do well on the AP Exam and obtain a deeper understanding of higher level mathematics.

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COURSE PLANNER

Below is the sequence of our AP Calculus AB Course

First Semester AP Calculus AB (20 weeks)

Section Numbers	Topics	Timeline
N/A	Real Numbers and the Coordinate Plane	Summer Packet
N/A	Lines and Linear Functions	
N/A	Polynomials and Rational Functions	
N/A	Algebra of Exponentials and Logarithms	
1.1	Equations of lines and applications	1 Day
1.2	Functions and Graphs	
1.3	Exponential Functions	
1.4	Parametric Equations	
1.5	Functions and Logarithms	
1.6	Trigonometric Functions	
N/A	The Idea of a Limit	.5 days
2.1	Rates of Change and Limits	1 day
2.2	Limits Involving Infinity	2 days
2.3	Continuity	1.5 days
2.4	Rates of Change and Tangent Lines	2 days
3.1	Derivative of a Function using the definition Differentiability and	2 days
3.2	Intermediate Value Theorem	1.5 days
3.3	Rules for Differentiation	3 days
3.4	Velocity and Other Rates of Change	2 days
3.5	Derivatives of Trigonometric Functions	2 days
3.6	Composition and the Chain Rule	3.5 days
3.7	Implicit Differentiation	3 days

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Section Numbers	Topics	Timeline
4.1	Extreme Values of Functions	1.5 days
4.2	Mean Value Theorem	2 days
4.3	Connecting f ¢ and f ¢¢ with the Graph of f	3 days
4.4	Modeling and Optimization	3 days
4.5	Linearization and Newton's Method	1.5 days
4.6	Related Rates	2.5 days
5.1	Estimating with Finite Sums	2.5 days
5.2	Definite Integrals	2 days
5.3	Definite Integrals and Anti-derivatives	2 days
5.4	Fundamental Theorem of Calculus – both parts	2.5 days
5.5	Trapezoidal Rule	2.5 days
6.2	Anti-differentiation by Substitution	3 days
6.4	Exponential Growth and Decay	3.5 days
6.5	Logistic Growth	2 days

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Second Semester of AP Calculus AB (18 weeks)

Section Numbers	Topics	Timeline
6.1	Slope Fields and Differential Equations	1.5 days
7.1	Integral As Net Change	3 days
7.2	Areas in the Plane	2 days
7.3	Volumes of known cross sections	3 days
7.3	Volumes using the Disk Method	2.5 days
7.3	Volumes using the Washer Method	2.5 days
7.3	Volumes using the Shell Method	2.5 days
8.2	L'Hospital's Rule	3.5 days
N/A	Derivatives of Inverse Functions	1.5 days

After the AP Exam

Section Numbers	Topics	Timeline
6.3	Integration by Parts	3 days
6.5	Partial Fractions	2 days
6.3	Inverse Trigonometric Anti-derivatives	3 days
6.3	Logarithmic Anti-derivatives	2 days
6.3	Miscellaneous Anti-derivatives	2 days

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TEACHING STRATEGIES

All of our students taking Calculus AB are from our honors track. They all completed and passed Pre Calculus the previous year. For these students, the expectations are considerably higher than they had been up to this point. A complete syllabus and tentative schedule is given to the students on day one. The teacher and student continuously work together toward a common goal of doing well on the AP Exam.

During the first few weeks, I spend extra time familiarizing students with their graphing calculators. Students are taught that ideas can be investigated analytically, graphically, and numerically. It is very important that the students understand that graphs and tables are not sufficient to prove an idea. Verification requires an analytic argument. I also stress communication as a major goal of the course. Students are expected to explain problems to each other, as well as to me. Often I have the students work in groups so they can help each other understand the key concepts.

TECHNOLOGY AND COMPUTER SOFTWARE

The teacher uses TI84 plus graphing calculator for presentations. All students either use this calculator or the TI89 graphing calculator. The graphing calculator is used to help students develop and understanding for the concepts before they begin solving problems through typical algebraic techniques. I use the calculator as a tool to illustrate ideas and certain topics. I always stress the required functionalities of this tool:

1. Finding a root (solution)
2. Using an appropriate window to sketch a graph
3. Approximating the derivative at a point using the 'nderiv' program
4. Approximating a definite integral using the 'fnint' program

Power Point presentations are also used for each lesson to aid in teaching the calculus concepts. I have a SmartBoards in my classroom that is used everyday during the calculus class. With his technology I can easily use many mathematical demonstrations from the internet to help illustrate topics such as Volume and Limits.

STUDENT EVALUATION

Quarter grades are computed using homework, math habits, quizzes, and tests as individual categories. The math habits grade includes participation, work ethic, and lateness to class. Each quarter grades represents 80 percent of the final grade. The final exam represents the remaining 20 percent of the grades. Students are allowed to use a graphing calculator on about half of the tests. Mock AP exams are used for many of the chapter tests where the format of the exam follows the AP format but on a smaller scale. Students also are given about six problem sets a year. The problem sets include past and present concepts using previous Free Response questions and multiple choice questions. Continuous review is always important in understanding all of the calculus concepts. AP review is incorporated into the syllabus prior to the exam.

TEACHER RESOURCES

Primary Textbook
Finney, Demana, Waits, and Kennedy. *Calculus: Graphical, Numerical, Algebraic*. 3rd ed. Boston: Person Prentice Hall, 2007

Technology Resources
Ralph, Bill in conjunction with Stewart, James. Journey Through Calculus. Brooks/Cole, 2000

Teacher's Tools®. Princeton Teaching Associates Software. Films for the Humanities and Sciences. 1998

Graphing calculators play a major role in both teaching and learning. Students are required to have a graphing calculator. The TI84 plus is recommended for Calculus AB. I have a virtual TI that I use regularly with the SmartBoard. This technology allows the teacher to use a wide variety of programs either on the internet or from other Calculus AP teachers' websites.

STUDENT ACTIVITIES

"Quality Control"
The following is an activity that I obtained from an in-service workshop; I modified it for my classes. It was intended to enhance my students' knowledge of Optimization. The graphing calculator allows the student to graph their functions to find either a minimum or maximum cost. The students are broken up into groups (the size depends on the number of students) and decide on a "leader". The leader presents the problem to the group and delegates specific problems to be analyzed and solved. The final analysis will be reported to the rest of the class. The main goal of this activity is for students to take an in-depth look at optimization and continuity. The focus is on (1) derivatives, (2) finding extreme values, and (3) analyzing graphs. The students in each group work together and present their conclusions in a written report that is graded based upon the correctness of the mathematics and the quality of the presentation. The report should conclude with ideas for a similar type of problem that other students could solve.

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LIMITS

I use the calculator table to zoom in on a limit value numerically, for example, to find

$$\lim_{x \to 3} \frac{x-3}{x^2-9}$$

We view the values of the function for 'x-values' from 2.5 to 3.5 with an increment step of 0.1.
At x = 3 the table states an "error". Students should see that the 'y-values' follow a pattern. We then look at the table using an increment step of 0.01, starting at 2.8. The students readily observe that the 'y-values' converge to a value of 1/6. Graphically, students see that the 'y-values' cluster at about .167 as x is near 3.

For comparison, we do the same exploration with

$$\lim_{x \to 3} \frac{x^2+9}{x-3}$$

This function is also undefined at x = 3, but the 'y' values do not converge to a specific value as x approaches 3. Instead the values increase more rapidly, giving students a numerical look at asymptotic behavior.

APPLICATIONS OF DERIVATIVES – IMPLICIT DIFFERENTIATION

I use the virtual TI84 plus on my SmartBoard.

Consider the set of all points (*x,y*) satisfying the equation $x-y^{2}-4=0$. I have the students describe what the graph should look like.

To get a better idea of what the graph actually looks like, we use implicit differentiation of find $\frac{dy}{dx}$

Knowing the derivative, I then ask them what we can conjure about the graph. We find possible values of *y* when *x* = 0 and refine our original conjecture about the graph. The original equation can be written as $x-y^{2}-4=0$. By factoring the expression on the left, write two equations whose graphs combine to give the graph of the original equation. Then sketch the graph. Students should see that the graph is consistent with the derivative found in the beginning of the problem.

SLOPE FIELDS

As an introduction to slope fields, I use an activity from the Teacher's AP Correlations and Preparation Guide – Calculus: Graphical, Numerical, Algebraic. This exploration helps students to see how a slope field is created. I place a 5 x 5 grid on my SmartBoard and assign each student a coordinate point in the region ((0,1), (1,1), (2,1), etc.)

For a specific differential equation, each student computes the slope at the assigned coordinate point and then draws a line on the grid to represent the slope at that position. The students realize that a larger slope values should have a steeper line drawn to represent the appropriate slope. Continuing in this manner, the class would complete the slope field. I then ask the students to start thinking about the graph of the original function, given a slope field.

DEFINITE INTEGRAL

After learning the concepts of RRAM, LRAM and MMRAM I challenge the students to determine which RAM is the Biggest. The students have discovered that the RRAM is a little high and the LRAM is a little low, with MRAM somewhere in between. That, however, depends on *n* and on the shape of the curve.

We graph: $y = 5 - 4\sin\left(\frac{x}{2}\right)$ in the window [0,3] by [0,5] on the graphing calculator. The students then copy the graph on paper and sketch the rectangles for the LRAM, MRAM, and RRAM sums with n = 3. Order the three approximations from greatest to smallest.

Graph $y=2\sin 5x+3$ in the same window. Copy the graph on paper and sketch the rectangles for the LRAM, MRAM, and RRAM sums with n=3. Order the three approximations from greatest to smallest.

The students analyze the graphs and I ask them what we can say about a positive, continuous function increasing on an interval in regard to the RAMS. They discuss the possibilities and realize that the RRAM is the biggest. I then ask them what we can conclude about a positive, continuous function decreasing on an interval. They realize that the LRAM would be the biggest.

PEDAGOGICAL ISSUES

I always encourage my students to explore and discover as much as possible. My lecturing time continuously decreases, as my students ask each other questions and try to find solutions. Investigating using the graphing calculators helps my students tremendously because they are "seeing" the concepts through graphs. I usually have two sections of AP Calculus with about 1012 students in each class. The students sit in groups of two or three and continuously help each other explain concepts that are difficult to initially understand. Before the AP exam, we review using old exam problems and other free response questions. Students are allowed to talk to each other about the problems. It is amazing how well they communicate the key concepts which allow them to justify their responses verbally and on their papers.