AP Calculus AB Syllabus

Course Description

-In AP Calculus AB, you will be learning the concepts of **calculus** in a **college-level course** with the intent of earning college credit! Our focus this year will be on understanding the basic elements of calculus using a multirepresentational approach, expressing concepts, results, and problems graphically, numerically, analytically, and verbally.

Goals

The goals of calculus are to recognize the connections among those representations while gaining a thorough understanding of limits, derivatives, integrals, and the Fundamental Theorem of Calculus. You should be able to effectively communicate your findings orally and in written sentences; model physical situations using calculus; use technology to solve problems, experiment, interpret results, and support your conclusions; and determine the reasonableness of solutions. Overall, you will surely gain an appreciation of calculus itself and those responsible for its development. Below, I have a detailed overview of our outline for the year.

Course Outline

Prerequisites for Calculus

1.1 Lines

Increments, Slope of a Line, Parallel and Perpendicular Lines, Equations of Lines, Applications

1.2 Functions and Graphs

Functions, Domains and Ranges, Viewing and Interpreting Graphs, Even Functions and Odd Functions - Symmetry, Functions Defined in Pieces, Absolute Value Function, Composite Functions

1.3 Exponential Functions

Exponential Growth, Exponential Decay, Applications, The Number e

1.4 Parametric Equations

Relations, Circles, Ellipses, Lines and Other Curves

*Parametric Equations Concepts Worksheet: Students work collaboratively to connect the analytical, numerical, and graphical representations of parametric equations.

1.5 Functions and Logarithms

One-to-One Functions, Inverses, Finding Inverses, Logarithmic Functions, Properties of Logarithms, Applications

1.6 Trigonometric Functions

Radian Measure, Graphs of Trigonometric Functions, Periodicity, Even and Odd Trigonometric Functions, Transformations of Trigonometric Graphs, Inverse Trigonometric Functions

*Graphical Analysis Concepts Worksheet: Students connect analytical and graphical representations of functions. They use graphing calculators to investigate solutions, domain, range, symmetry, and periodicity of parent functions.

Chapter 1 Test

Limits and Continuity

2.1 Rates of Change and Limits

Average and Instantaneous Speed, Definition of Limit, Properties of Limits, One-sided and Two-sided Limits, Sandwich Theorem

2.2 Limits Involving Infinity

Finite Limits as $x \to \pm\infty$, Sandwich Theorem Revisited, Infinite Limits as $x \to a$, end Behavior Models, "Seeing" Limits as $x \to \pm\infty$

2.3 Continuity

Continuity at a Point, Continuous Functions, Algebraic Combinations, Composites, Intermediate Value Theorem for Continuous Functions

*End Behavior Models and Continuity Concepts Worksheet: Students investigate both concepts from a graphical approach.

2.4 Rates of change and Tangent Lines

Average Rates of Change, Tangent to a Curve, Slope of a Curve, Normal to a Curve, Speed Revisited

Chapter 2 Test

Concept of and Basic Derivatives

3.1 Derivative of a Function

Definition of a Derivative, Notation, Relationship Between the Graphs of f and f', Graphing the Derivative from Data, One-sided Derivatives

*Derivatives Matching Activity: Students will work in partners to match the graphs of functions and their derivatives, written descriptions of derivatives with their graphs, and written descriptions of functions with their graphs.

*Differentiation Concepts Worksheet: Students evaluate derivatives using numerical data.

3.2 Differentiability

How $f'(a)$ Might Fail to Exist, Differentiability Implies Local Linearity, Derivatives on a Calculator, Differentiability Implies Continuity, Intermediate Value Theorem for Derivatives

3.3 Rules for Differentiation

Positive Integer Powers, Multiples, Sums, and Differences, Products and Quotients, Negative Integer Powers of x, Second and Higher Order Derivatives

3.4 Velocity and Other Rates of Change

Instantaneous Rates of Change, Motion along a Line, Sensitivity to change, Derivatives in Economics

*Speed Activity: Students investigate different scenarios involving velocity and acceleration to draw conclusions about speed.

*Velocity, Speed, and Acceleration Concepts Worksheet: Students use analytical and graphical representations to investigate the relationship among position, velocity, speed, and accelerations. They use graphing calculators to explore parametric equations.

Chapter 3A Test

Derivatives of Trigonometric, Exponential, and Logarithmic Functions, The Chain Rule, and Implicit Differentiation

3.5 Derivatives of Trigonometric Functions

Derivative of the Sine Function, Derivative of the Cosine Function, Simple Harmonic Motion, Jerk, Derivatives of Other Basic Trigonometric Functions

3.6 Chain Rule

Derivative of a Composite Function, "Outside-Inside" Rule, repeated Use of the Chain Rule, Slopes of Parametrized Curves, Power Chain Rule

3.7 Implicit Differentiation

Implicitly Defined Functions, Lenses, Tangents, and Normal Lines, Derivatives of Higher Order, Rational Powers of Differentiable Functions

*Implicit Differentiation Concepts Worksheet: Students work collaboratively to analytically approach implicit differentiation.

3.8 Derivatives of Inverse Trigonometric Functions

Derivatives of Inverse Functions, Derivative of the Arcsine, Derivative of the Arctangent, Derivative of the Arcsecant, Derivatives of the Other Three

*Inverse Functions Concepts Worksheet: Students graph inverse functions based solely on their graphs and find inverses numerically.

3.9 Derivatives of Exponential and Logarithmic Functions

Derivative of e^x, Derivative of a^x, Derivative of $\ln x$, derivative of $\log_a x$, Power Rule for Arbitrary Real Powers

*e Concepts Worksheet: Students use graphing calculators to explore the derivatives of exponential functions.

Chapter 3B Test

Applications of Derivatives

4.1 Extreme Values of Functions

Absolute (Global) Extreme Values, Local (Relative) Extreme Values, Finding Extreme Values

*An Unusual Function Concepts Worksheet: Students analyze one graph, naming and classifying all points of interest. Then they sketch the derivative of the function.

4.2 Mean Value Theorem

Mean Value Theorem, Physical Interpretation, Increasing and Decreasing Functions, Other Consequences

*Theorems of Calculus Concepts Worksheet: Students make connections between Rolle's Theorem and the Mean Value Theorem and graphs of functions.

4.3 Connecting f' and f'' with the Graph of f

First Derivative Test for Local Extrema, Concavity, Points of Inflections, Second Derivative Test for Local Extrema, Learning about Functions from Derivatives

*Using the Candidate Test Group Exploration: Students learn about the Candidate Test as a way to test for absolute extrema.

*Graph Sketching Using Derivatives Concepts Worksheet: Students sketch graphs using numerical and analytical data. Then they verbally explain their answers in small groups.

4.4 Modeling and Optimization

Examples from Mathematics, Examples from Business and Industry, Examples from Economics, Modeling Discrete Phenomena with Differentiable Functions

4.5 Linearization and Newton's Method

Linear Approximations, Newton's Method, Differentials, Estimating Change with Differentials, Absolute, Relative, and Percentage Change, Sensitivity to Change

4.6 Related Rates

Related Rate Equations, Solution Strategy, Simulating Related Motion

Chapter 4 Test

Semester Exam

<u>The Definite Integral</u>

5.1 Estimating with Finite Sums

Distance Traveled, Rectangular Approximations Method (RAM), Volume of a Sphere, Cardiac Output

5.2 Definite Integrals

Riemann Sums, Terminology and Notation of Integrations, Definite Integral and Area, Constant Functions, Integrals on a Calculator, Discontinuous Integrable Functions

5.3 Definite Integrals and Antiderivatives

Properties of Definite Integrals, Average Value of a Function, Mean Value Theorem for Definite Integrals, Connecting Differential and Integral Calculus

5.4 Fundamental Theorem of Calculus

Fundamental Theorem, Part 1, Graphing the Function $\int_a^x f(t)dt$, Fundamental Theorem, Part 2, Area Connection, Analyzing Antiderivatives Graphically

*The Fundamental Theorem of Calculus with a Twist Exploration: Students rearrange the FTC to solve past AP questions. They explain their work in written sentences and connect different representations of problems.

*Graphical Antidifferentiation Concepts Worksheet: Students work collaboratively to sketch functions given only their derivatives and initial values.

5.5 Trapezoidal Rule

Trapezoidal Approximations, Other Algorithms, Error Analysis

*Definite Integral Approximations Concepts Worksheet: Students explain in sentences the differences among different means of approximation and definite integral values for specific functions.

Chapter 5 Test

<u>Differential Equations and Mathematical Modeling</u>

6.1 Slope Fields and Euler's Method

Differential Equations, Slope Fields, Euler's Method

*Slope Fields Group Activity: Students explore slope fields with a graphing calculator and match slope fields and equations.

6.2 Antidifferentiation by Substitution

Indefinite Integrals, Leibniz Notation and Antiderivatives, Substitution in Indefinite Integrals, Substitution in Definite Integrals

*Logarithmic Function Concepts Worksheet: Students draw connections between integral notation and the corresponding shaded regions on graphs of functions.

6.3 Antidifferentiation by Parts

Product Rule in Integral Form, Solving for the Unknown Integral, Tabular Integration, Inverse Trigonometric and Logarithmic Functions

6.4 Exponential Growth and Decay

Separable Differential Equations, Law of Exponential Change, Continuously Compounded Interest, Radioactivity, Modeling Growth with Other Bases, Newton's Law of Cooling

6.5 Logistic Growth

How Populations Grow, Partial Fractions, The Logistic Differential Equation, Logistic Growth Models

Chapter 6 Test

Applications of Definite Integrals

7.1 Integral As Net Change

Linear Motion Revisited, General Strategy, Consumption Over Time, Net Change from Data, Work

7.2 Areas in the Plane

Area Between Curves, Area Enclosed by Intersecting Curves, Boundaries with Changing Functions, Integrating with Respect to *y*, Saving Time with Geometry Formulas

*Area as a Definite Integral Concepts Worksheet: Students make connections between graphs and analytical notation when finding the area under a curve.

7.3 Volumes

Volume As an Integral, Square Cross Sections, Circular Cross Sections, Cylindrical Shells, Other Cross Sections

*Volume as a Definite Integral Concepts Worksheet: Students make connections between graphs and analytical notation when finding the volume of a solid of revolution.

*The Definite Integral as an Accumulator Exploration: Students connect analytical and graphical representations to find area, volume, net displacement, and net change.

7.4 Lengths of Curves

A Sine Wave, Length of Smooth Curve, Vertical Tangents, Corners, and Cusps

7.5 Applications from Science and Statistics

Work Revisited, Fluid Force and Fluid Pressure, Normal Probabilities

Chapter 7 Test

8.2 L'Hôpital's Rule

Indeterminate Form 0/0, Indeterminate Forms ∞/∞, $\infty - 0$ and $\infty - \infty$, Indeterminate Forms 1^{∞}, 0^0, ∞^0

Lesson 8.2 Quiz

This schedule leaves approximately four weeks of flexibility for teaching and learning time throughout the course and review before the AP Calculus AB exam.

Major Text

-*Calculus-Graphical, Numerical, Algebraic.* Finney, Ross L., Franklin D. Demana, Bert K. Waits, and Daniel Kennedy. 3rd ed. Boston: Pearson Prentice Hall, 2007.

Supporting Materials

-*Teacher's AP Correlations and Preparation Guide*. Finney, Ross L., Franklin D. Demana, Bert K. Waits, and Daniel Kennedy. Boston: Pearson Prentice Hall, 2007.

Technology

-A **graphing calculator is required this year.** I will be using the TI-Smart View 84 Emulator in class this year to enhance our study of calculus. We will use calculators to solve problems, experiment, interpret results, and support our conclusions. The AP Calculus AB exam requires the use of a graphing calculator in both its multiple choice and free response sections. As such, you will, at a minimum, learn to graph functions, find the zeros of functions, calculate numerical derivatives, and calculate numerical integrals.

Extra Help and Study Sessions

If you have any questions or don't understand something, feel free to contact me or visit me before or after school. I am **always willing** to help anyone who wants it.

Starting during the third nine weeks, I will begin offering study sessions for the AP Calculus AB exam. These sessions will supplement what you learn in class and on your own. Hopefully, they will make you more prepared for the exam.

Assessment

-Your grade in AP Calculus will be based on total points. Chapter tests and quizzes will account for the majority of your grade. Homework and projects will contribute with much less emphasis. All chapter tests will be modeled after the AP Calculus AB exam offered on **May 9, 2017**. For example, each test will have multiple choice and free response sections, which will receive equal weight. Most questions are past AP Exam questions and will be graded using AP Exam scoring guidelines. As such, you will need to communicate your solutions to free response questions in written sentences. Tests contain both non-calculator and calculator sections and will learn toward more non-calculator questions, also similar to the AP exam.

-Minster High School's grading scale is as follows:

	95-100 A	93-94 A-
91-92 B+	85-90 B	83-84 B-
81-82 C+	75-80 C	73-74 C-
71-72 D+	67-70 D	66 D-
	65 & below F	

Expectations

-For me: Teach you the math skills you need, teach you how to think mathematically, and be fair.

-For you: Always be thinking, try your best, and SUCCEED!

***I have high expectations for each and every one of you, and I expect you to surpass them!!**

Course Requirements

*Supplies: pencil, eraser, pen, notebook, covered textbook, and graphing calculator

*Actions:

1. Do your homework! Perfect practice makes perfect! [Be in your seat and have your homework out when class starts.]
2. Always be ready to ask questions and participate in class.
3. Study outside of school - This is a college-level class and due to the rigor of the material, you will need to spend extra time studying to do well.

Let's have a great year together!

Mrs. Schumann