Anoka-Hennepin Secondary Curriculum Unit Plan

Department:	**Math**	**Course:**	**AP Calculus AB Test Prep/Enrichment**	**Unit 3 Title:**	**Post AP Topics**	**Grade Level(s):**	**12**
Assessed Trimester:	**Trimester A**	**Pacing:**	**20-24 days**	**Date Created:**	**4/27/2011**	**Last Revision Date:**	**6/16/2011**

Course Understandings: *Students will understand that:*

A. The meaning of limit represents function behavior.
B. The meaning of the derivative represents a rate of change and is a local linear approximation and should understand that derivatives can be used to solve a variety of problems.
C. The meaning of the definite integral is a limit of Riemann sums and as the net accumulation of change and will understand that you can use integrals to solve a variety of problems.
D. The relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
E. You can model a written description of a physical situation with a function, a differential equation, or an integral.
F. You can use technology to help solve problems, experiment, interpret results, and support conclusions.

DESIRED RESULTS (Stage 1) - WHAT WE WANT STUDENT TO KNOW AND BE ABLE TO DO?

Established Goals

Minnesota State/Local/Technology Standard(s) addressed:

- **Advanced Placement (AP) - AP CollegeBoard: Functions, Graphs, Limits, Derivatives, Integrals**
  a. **Analysis of graphs**
     - With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.
  b. **Limits of functions (including one-sided limits)**
     - An intuitive understanding of the limiting process
     - Calculating limits using algebra
     - Estimating limits from graphs or tables of data
  c. **Asymptotic and unbounded behavior**
     - Understanding asymptotes in terms of graphical behavior
     - Describing asymptotic behavior in terms of limits involving infinity
     - Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)
  d. **Continuity as a property of functions**
     - An intuitive understanding of continuity.
  e. **Concept of the derivative**
     - Derivative presented graphically, numerically, and analytically
     - Derivative interpreted as an instantaneous rate of change
     - Derivative defined as the limit of the difference quotient
     - Relationship between differentiability and continuity
  f. **Derivative at a point**
     - Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.
     - Tangent line to a curve at a point and local linear approximation
     - Instantaneous rate of change as the limit of average rate of change
     - Approximate rate of change from graphs and tables of values
  g. **Derivative as a function**
     - Corresponding characteristics of graphs of f and f'
     - Relationship between the increasing and decreasing behavior of f and the sign of f'
     - The Mean Value Theorem and its geometric interpretation
     - Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.

h. **Second derivatives**
   - Corresponding characteristics of the graphs of f, f', and f''
   - Relationship between the concavity of f and the sign of f''
   - Points of inflection as places where concavity changes
i. **Computation of derivatives**
   - Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions
   - Derivative rules for sums, products, and quotients of functions
   - Chain rule and implicit differentiation
j. **Interpretations and properties of definite integrals**
   - Definite integral as a limit of Riemann sums
   - Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval:
   - Basic properties of definite integrals (examples include additivity and linearity)
k. **Applications of integrals**
   - Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include finding the area of a region, the volume of a solid with known cross sections, the average value of a function, the distance traveled by a particle along a line, and accumulated change from a rate of change.
l. **Fundamental Theorem of Calculus**
   - Use of the Fundamental Theorem to evaluate definite integrals
   - Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined
m. **Techniques of antidifferentiation**
   - Antiderivatives following directly from derivatives of basic functions
   - Antiderivatives by substitution of variables (including change of limits for definite integrals)
n. **Applications of antidifferentiation**
   - Finding specific antiderivatives using initial conditions, including applications to motion along a line
   - Solving separable differential equations and using them in modeling (including the study of the equation $y=ky$ and exponential growth)
o. **Numerical approximations to definite integrals**
   - Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values

Transfer

Students will be able to independently use their learning to: (product, high order reasoning)
- Various Projects (teacher determined)

Meaning

Unit Understanding(s):	Essential Question(s):
Students will understand that: • General ideas and applications for one or more of the following topics: a. Vectors b. Shells c. Differential Equations/Logistic Growth d. Parametric Equations e. Euler's Method f. Integration by Parts g. L'Hopital's Rule h. Partial Fractions i. Work/Force j. Arc Length	**Students will keep considering:** • How do the topics being covered connect AB and BC Calculus?

Acquisition

Knowledge - Students will:	Skills - Students will:
• Limits • Asymptotes • Continuity/Discontinuity • Definition of the Derivative • Derivative Notation • First and Second Derivative Test for Extrema • Concavity Test • Position, velocity, and acceleration • Related Rates • Normal and Tangent Lines • Derivatives on a calculator • Increasing/Decreasing functions • Mean Value Theorem Integral Notation • Definition of Integral • Integral approximation methods • FTOC (part 1 and 2) • Slope Field • Integrals on a calculator • Area and Volume • Integral Rules **Reasoning - Students will:** • Analyze position, velocity and acceleration of a particle using parametric equations. • Analyze graphs to determine how to set up integrals to calculate arc length • Justify the second derivative rule for parametric equations using the chain rule. • Determine when L'Hopital's rule applies • Compare growth rates of functions • Determine when an approximation using Euler's method is needed • Interpret arc length as distance traveled or displacement • Analyze characteristics of population growth using logistic growth models	• BC1-1 Use L'Hopital's rule to evaluate a limit • BC1-3 Evaluate an integral using partial fractions • BC1-4 Evaluate an integral using integration by parts • BC1-5 Use Euler's Method to approximate the value of a function • BC1-6 Calculate the length of a curve • BC1-7 Solve a logistic growth differential equation • BC3-1 Graphing the path of a particle in parametric form • BC3-4 Calculate first and second derivative of parametric curves • BC3-5 Convert between parametric and rectangular forms • BC3-8 Using parametric equations to determine extrema

Common Misunderstandings	Essential new vocabulary
• Students overuse L'Hopital's rule • Students struggle converting parametric to rectangular • Students misunderstand how to take the second derivative of parametric equations • Students have a hard time visualizing and drawing shells	• Arc Length • Euler's Method • Improper Fraction • Indeterminant Form • L'Hopital's Rule • Logistic Growth • Magnitude • Parameter • Parametric Equation • Partial Fraction • Shell • Vector