*AP Calculus BC (#9550)

Description This course is an in-depth development and extension of the concepts of calculus that were introduced to the students in Introduction to Calculus. Topics from both differential and integral calculus comparable to a two-semester college offering are studied. Students may elect to take an Advanced Placement Calculus (AB or BC) Examination in May for possible college credit.

Credits 1

Prerequisites AP Calculus AB or (PreCalculus with approval of both PreCalculus and AP Calculus instructors)

Textbooks/Resources Sullivan, Michael & Miranda, Kathleen. *Calculus.* 2nd Edition
Bedford, Freeman & Worth High School Publishers, 2017 (ISBN 978-1-4641-4226-0)

Required Assessments District Wide Assessment created by AP Calculus teachers

Board Approved May 1997

Revised April 1999; April 2008, November 2009, May 2018

AASD Mathematics Goals for K-12 Students

When engaging with Mathematics, students in the Appleton Area School District will ...

- *Make sense of problems and persevere in solving them*
- *Use numbers and words to reason and make sense of problems*
- *Explain own mathematical thinking and critique the reasoning of others*
- *Recognize and use mathematical models*
- *Use appropriate tools and strategies*
- *Clearly and precisely communicate ideas when solving problems*
- *Look for structure and patterns*
- *Create more efficient strategies*

AASD Mathematics Standards for Grades 9-12 Students

Mathematical Practice Standards

1. Make Sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Mathematics Content Standards	
Domain	***Cluster***
I. Number and Quantity	A. The Real Number System B. Quantities C. The Complex Number System
II. Algebra	A. Seeing Structure in Expressions B. Arithmetic with Polynomials and Rational Expressions C. Creating Equations D. Reasoning with Equations and Inequalities
III. Functions	A. Interpreting Functions B. Building Functions C. Linear, Quadratic, and Exponential Models D. Trigonometric Functions
IV. Geometry	A. Similar Right Triangles and Trigonometry B. Expressing Geometric Properties with Equations C. Geometric Measure and Dimension D. Modeling with Geometry

Essential Learning Objectives	Performance Indicators	Classroom Assessments
1. Develop deep conceptual understanding of calculus by engaging in mathematical practices of AP Calculus.	**Performance will be satisfactory when the student:** a. use definitions and theorems to build arguments, to justify conclusions or answers, or to prove results. b. connects concepts by identifying the underlying structure of a problem. c. determines appropriate strategies while implementing algebraic and computational processes correctly d. connects multiple representations by developing concepts using symbolic, graphical, and numerical representations with and without technology. e. builds notational fluency to use and interpret different notations within context. f. communicates effectively using mathematical language within reasoning and/or justification.	• All assessments
Objectives are linked to the Mathematical Practices Standards		

Essential Learning Objectives	Performance Indicators	Classroom Assessments
2. Apply the properties of functions, graphs and limits.	**Performance will be satisfactory when the student:** g. reviews the properties of functions. h. reviews the properties of graphs. i. develops an intuitive understanding of the limiting process. j. estimates limits from graphs or tables of data. k. calculates limits using graphical, numerical, or algebraic techniques. l. describes asymptotes in terms of graphical behavior, infinite limits, and limits at infinity. m. compares exponential, polynomial and logarithmic growth. n. defines continuity in terms of limits: $\lim_{x \to a} f(x)=f(a)$. o. interprets graphically and algebraically continuous functions, Intermediate Value Theorem and Extreme Value Theorem. p. analyzes planar curves utilizing rectangular, parametric, polar and vector forms.	• Unit assessment
Objectives are linked to the following AASD Mathematics standards: I. Number and Quantity; II. Algebra; III. Functions, IV. Geometry		

Essential Learning Objectives	Performance Indicators	Classroom Assessments
3. Develop the concept of derivatives.	**Performance will be satisfactory when the student:** a. defines the derivative in terms of the limit of the difference quotient. b. explores the relationship among limits, continuity and differentiability. c. finds the derivative at a point as it applies to the slope of a curve. d. determines the tangent line to a curve at a point and a local linear approximation. e. interprets instantaneous rate of change as the limit of average rate of changes. f. investigates corresponding characteristics of the graphs of **f**, **f'** and **f"**. g. determines the relationship between the increasing and decreasing behavior of **f** and the sign of **f**'. h. determines the relationship between the increasing and decreasing behavior of **f** and the sign of **f"**. i. finds critical and inflection points. j. applies the Mean Value Theorem. k. proves the basic rules for the derivative of sums, products, and quotients of functions. l. applies the basic rules for the derivative of sums, products, and quotients of functions. m. computes derivatives of polynomial, circular, logarithmic, exponential, parametric, polar, and vector functions. n. applies the Chain rule and implicit differentiation.	• Unit assessment
Objectives are linked to the following AASD Mathematics standards: I. Number and Quantity; II. Algebra; III. Functions, IV. Geometry		

Essential Learning Objectives	Performance Indicators	Classroom Assessments
4. Apply derivatives in solving real world problems.	**Performance will be satisfactory when the student:** a. analyzes curves, including the notions of slope, monotonicity and concavity.	• Unit assessment

	b. analyzes planar curves given in parametric form, polar form, and vector form, including velocity and acceleration vectors. c. interprets the derivative as a rate of change in varied applied contexts. d. identifies both absolute (global) and relative (local) extrema. e. models rates of change, including related rates problems. f. uses implicit differentiation to find the derivative of an inverse function. g. applies l'Hopital's Rule to indeterminate forms. h. analyzes differential equations geometrically via slope fields, numerically using Euler's Method, and algebraically for the separable variety.	
Objectives are linked to the following AASD Mathematics standards: I. Number and Quantity; II. Algebra; III. Functions, IV. Geometry		

Essential Learning Objectives	Performance Indicators	Classroom Assessments
5. Interpret the concepts of integrals.	**Performance will be satisfactory when the student:** a. finds antiderivatives utilizing basic derivative rules. b. develops the concept of a Riemann sum over equal subdivisions. c. computes Riemann sums using left, right and midpoint evaluation points. d. defines an integral as a limit of Riemann sums. e. uses Riemann sums with Simpson's Rule and the Trapezoidal Rule to approximate definite integrals of functions represented algebraically, geometrically and numerically. f. uses the Fundamental Theorem of Calculus to evaluate definite integrals. g. uses the basic properties of definite integrals in evaluation. h. analyzes graphically and analytically a function defined as $\mathbf{g(x) = \int_a^x f(t)dt.}$ i. determines antiderivatives by substitution of variables (including changes of limits for definite integrals), parts, and simple partial fractions (nonrepeating linear factors only).	• Unit assessment

	j. evaluates, if possible, improper integrals as limits of definite integrals.	
Objectives are linked to the following AASD Mathematics standards: I. Number and Quantity; II. Algebra; III. Functions, IV. Geometry		

Essential Learning Objectives	Performance Indicators	Classroom Assessments
6. Apply integrals in solving real world problems.	**Performance will be satisfactory when the student:** a. finds specific antiderivatives using initial conditions, including applications to motion along a line. b. solves separable differential equations. c. uses separable differential equations in modeling, especially when applying the equations **y'=ky** and exponential growth. d. solves logistic differential equations. e. uses logistic differential equations in modeling. f. find the area of a region (including a region bounded by polar curves). g. finds the volume of a solid with known cross sections. h. finds volumes of solids of revolution using disc and washer methods (and shell method if time allows). i. finds the average value of a function. j. determines the length of a curve (including parametric curves). k. determines the area of a surface of revolution. l. utilizes appropriate integrals in a variety of applications to model physical, social or economic situations.	• Unit assessment
Objectives are linked to the following AASD Mathematics standards: I. Number and Quantity; II. Algebra; III. Functions, IV. Geometry		

Essential Learning Objectives	Performance Indicators	Classroom Assessments
7. Explore the concept of	**Performance will be satisfactory when the student:** a. defines a series as a sequence of partial sums.	• Unit assessment

polynomial approximations and series.	b. defines convergences as a limit of the sequence of partial sums. c. utilizes the geometric, harmonic, alternating or p-series in determining convergence or divergence. d. determines convergence or divergence utilizing the ratio, root or integral test. e. determines absolute convergence vs. conditional convergence when a series converges. f. represents a function as a Taylor approximation. g. produces the Maclaurin series for the functions e^x, sin x, cos x, and 1/(1-x). h. manipulates Taylor series by employing differentiation, integration, and the formation of new series from known series. i. determines the radius and interval of convergence for power series. j. examines the Lagrange error bound for Taylor polynomials.	
Objectives are linked to the following AASD Mathematics standards: I. Number and Quantity; II. Algebra; III. Functions		

Resources and learning activities that address course objectives:

AP College Board AP Calculus BC Curriculum Framework
https://secure-media.collegeboard.org/digitalServices/pdf/ap/ap-calculus-ab-and-bc-course-and-exam-description.pdf