

## Wilson Area School District Planned Course Guide

**Title of planned course:** AP Calculus AB

**Subject Area:** Math

**Grade Level:** 10-12

**Course Description:** AP® Calculus AB is equivalent to a first-semester college calculus course. Topics include functions, limits and continuity, derivatives, and integrals. The course will focus on applying the skills and concepts of calculus to modeling and solving problems across multiple representations.

**Time/Credit for this Course:** One Full Academic Year / 1.0 Credit

**Curriculum Writing Committee:** Christal Vitko

## Curriculum Map

**August:**

Limits and Continuity

**September:**

Limits and Continuity

**October:**

Differentiation

**November:**

Differentiation

**December:**

Applications Differentiation

**January:**

Applications of Differentiation

**February:**

Integration and Accumulation of Change

**March:**

Differential Equations and Slope Fields

**April:**

Applications of Integration  
AP Exam Review

**May:**

AP Exam Review  
Student Video Projects

**June:**

Student Video Projects

## Wilson Area School District Planned Course Materials

**Course Title:** AP Calculus AB

**Textbooks:**

- Sullivan, Michael, and Kathleen Miranda. *Calculus for the AP® Course*. 2nd edition. Bedford, Freeman and Worth Publishing Group.
- Finney, Ross L., Franklin Demana, Bert Waits, and Daniel Kennedy. *Calculus: Graphical, Numerical, Algebraic*. Reading, Mass.: Addison Wesley, 1999.

**Supplemental Books:**

- Edwards, Bruce. and Larson, Ron. *Calculus of a Single Variable: Early Transcendental Functions*. Boston, Mass.: Brooks/Cole, Cengage Learning, 2011.
- Rogawski, Jon. *Single Variable Calculus*. New York, NY.: W.H. Freeman and Company, 2008.

**Teacher Resources:**

- Teacher created handouts/activities
- Internet Resources
- College Board AP Classroom
- TI-Smartview

## Curriculum Scope & Sequence

**Planned Course:** AP Calculus AB

**Unit:** Limits and Continuity

**Time frame:** 12 - 14 Blocks

**Anchor(s) or adopted anchor (College Board):** CHA-1.A, LIM-1.A, LIM-1.B, LIM-1.C, LIM-1.D, LIM-1.E, LIM-2.A, LIM-2.B, LIM-2.D, FUN-1.A

**Essential content/objectives:** At end of the unit, students will be able to:

- Define limits and use limit notation
- Estimate limits from tables and graphs
- Determine limits using algebraic properties and of limits
- Determine limits using algebraic manipulation
- Determine limits using the Squeeze Theorem
- Identify types of discontinuities and where they exist
- Define continuity and use the definition to confirm continuity at a point
- Connect infinite limits and vertical asymptotes
- Connect limits at infinity and horizontal asymptotes
- Use the Intermediate Value Theorem to prove the existence of a value

**Core Activities:** Students will complete/participate in the following:

- Daily warm-ups and exit tickets
- Guided and independent practice
- Pair and group practice
- Think-Write-Pair-Share activities
- Student reflection and vocabulary practice in journals
- Peer teaching
- Using alternate methods to solve problems
- Use, select, and discuss solved problems to analyze algebraic reasoning and strategies
- What Can I Say Writing Activity
- Directions for a Friend Activities
- Matching activity for limits and functions: students will sort cards pertaining to the graph of a function  $f$  consisting of vertical asymptotes, horizontal asymptotes, jump, removable, and nonremovable discontinuities. Students will have to match selected portions of the graph to its written description and symbolic (notation) description. Here, students are learning how to express limits in both written and symbolic form to understand the behavior of a function  $f$  as  $f$  gets sufficiently close to a particular  $x$ -value

**Extensions:** Released AP Free Response Questions

**Remediation:**

- College Board's AP Classroom Progress Checks
- Instructional Videos.

**Instructional Methods:**

- Explicit Instruction
- Model use of graphing calculator
- Flipped/Hybrid
- Facilitate discussion and group work

**Materials & Resources:**

- Note-taking guides
- Teacher made handouts/activities
- Graphing Calculators
- Computers
- Journals

**Assessments:**

- Homework Assignments
- Journal entries
- Quizzes
- Tests

## Curriculum Scope & Sequence

**Planned Course:** AP Calculus AB

**Unit:** Derivatives

**Time frame:** 18 - 20 Blocks

**Anchor(s) or adopted anchor (College Board):** CHA-2.A, CHA-2.B, CHA-2.C, CHA-2.D, FUN-2.A, FUN-3.A, LIM-3.A, FUN-3.B, FUN-3.C, FUN-3.D, FUN-3.E, FUN-3.F

**Essential content/objectives:** At end of the unit, students will be able to:

- Determine and compare average and instantaneous rate of change
- Estimate derivatives at a point
- Define differentiability and determine when derivatives do not exist
- Determine derivatives using the power, constant, sum and difference rules
- Differentiate trig, exponential and log functions
- Determine derivatives using the product and quotient rules
- Determine derivatives using the chain rule
- Differentiate inverse functions and inverse trig functions
- Select procedures for calculating derivatives and higher order derivatives

**Core Activities:** Students will complete/participate in the following:

- Daily warm-ups and exit tickets
- Guided and independent practice
- Pair and group practice
- Think-Write-Pair-Share activities
- Student reflection and vocabulary practice in journals
- Peer teaching
- Using alternate methods to solve problems
- Use, select, and discuss solved problems to analyze algebraic reasoning and strategies
- What Can I Say Writing Activity
- Directions for a Friend Activities
- In a class activity, students will use their graphing calculator to discover the power rule for derivatives. Students will enter functions such as,  $y = x$ ,  $y = x^2$ ,  $y = x^3$  into their calculators and graph the derivatives of the functions one at a time in order to explore the graphs and make a conjecture about the derivative of a power function. Then, students will use the strategy of turn and talk to try and generalize a rule for finding the derivative of a power function
- In a class exercise, students will work in pairs to discuss how they would solve Free-Response Question 3 – Part C from 2007 (Form B)
- In a class activity, students will work in pairs using the flowchart from Teaching and Assessing Module 2 to determine which derivative rule to apply to a given function. The functions are represented as  $f(x)$ ,  $y$ , etc. One student will show the other student how to select the derivative procedure while the other student explains why they agree or disagree with the procedure chosen. Both students then find the derivative using appropriate symbols for the derivative. They check their answers and notation. Students will switch roles after each problem

**Extensions:** Released AP Free Response Questions

**Remediation:**

- College Board's AP Classroom Progress Checks
- Instructional Videos

**Instructional Methods:**

- Explicit Instruction
- Model use of graphing calculator
- Flipped/Hybrid
- Facilitate discussion and group work

**Materials & Resources:**

- Note-taking guides
- Teacher made handouts/activities
- Graphing Calculators
- Computers
- Journals

**Assessments:**

- Homework Assignments
- Journal entries
- Quizzes
- Tests

## Curriculum Scope & Sequence

**Planned Course:** AP Calculus AB

**Unit:** Applications of Differentiation

**Time frame:** 18 - 20 Blocks

**Anchor(s) or adopted anchor (College Board):** CHA-3.A, CHA-3.B, CHA-3.C, CHA-3.D, CHA-3.E, CHA-3.F, LIM-4.A, FUN-1.B, FUN-1.C, FUN-4.A, FUN-4.B, FUN-4.C, FUN-4.D, FUN-4.E

**Essential content/objectives:** At end of the unit, students will be able to:

- Explain the meaning of the derivative in context
- Solve problems involving straight-line motion (connecting position, velocity, and acceleration)
- Solve related rates problems
- Approximate values of a function using linearization
- Use L'Hospital's rule for determining limits of indeterminate forms
- Solve problems using the Mean Value Theorem and Extreme Value Theorem
- Analyze functions and their graphs using derivatives (locate extrema, critical points, increasing or decreasing behavior)
- Use the First and Second Derivative Test to justify local extrema
- Use the Candidates Test to justify absolute extrema
- Determine concavity and points of inflection using second derivatives
- Sketch or match functions with their derivatives or vice versa
- Solve optimization problems
- Differentiate functions defined implicitly

**Core Activities:** Students will complete/participate in the following:

- Daily warm-ups and exit tickets
- Guided and independent practice
- Pair and group practice
- Think-Write-Pair-Share activities
- Student reflection and vocabulary practice in journals
- Peer teaching
- Using alternate methods to solve problems
- Use, select, and discuss solved problems to analyze algebraic reasoning and strategies
- What Can I Say Writing Activity
- Directions for a Friend Activities
- In a class activity, students will work in pairs. One student will draw a picture and label the quantities that change as variables and then pass it on to their partner for verification. Once the pair agrees on the picture and labels, they will individually write an equation that relates the quantities in the problem and switch papers to see if they agree with each other's equations. Then, the students will differentiate the equation together agreeing on their steps in finally solving the problem



- In a class activity, students in pairs will be given a set of four index cards with graphs of several functions (polynomials, functions with corner points, and functions with vertical asymptotes). The first student will graph a function on an index card and pass the card to their partner who will sketch the derivative of that function. The second person will sketch a derivative of some function and pass the card to their partner who will sketch the function given the derivative card. Each pair will do this twice so that each student gets a turn at sketching the derivative given the function and sketching the function given the derivative

**Extensions:**

- View motion on a line using the parametric mode on the graphing calculator
- Released AP Free Response Questions

**Remediation:**

- College Board's AP Classroom Progress Checks
- Instructional Videos

**Instructional Methods:**

- Explicit Instruction
- Model use of graphing calculator
- Flipped/Hybrid
- Facilitate discussion and group work

**Materials & Resources:**

- Note-taking guides
- Teacher made handouts/activities
- Graphing Calculators
- Computers
- Journals

**Assessments:**

- Homework Assignments
- Journal entries
- Quizzes
- Tests

## Curriculum Scope & Sequence

**Planned Course:** AP Calculus AB

**Unit:** Integration

**Time frame:** 18- 20 Blocks

**Anchor(s) or adopted anchor (College Board):** CHA-4.A, LIM-5.A, LIM-5.B, LIM-5.C, FUN-5.A, FUN-6.A, FUN-6.B, FUN-6.C, FUN-6.D

**Essential content/objectives:** At end of the unit, students will be able to:

- Explain/communicate accumulation of change for a given function
- Approximate areas with Riemann Sums
- Express definite integrals as limits of Riemann sums using Summation Notation
- Use the Fundamental Theorem of Calculus to evaluate accumulation functions
- Interpret the behavior of accumulation functions involving area
- Apply properties of definite integrals
- Use the Fundamental Theorem of Calculus to calculate definite integrals
- Determine antiderivatives and indefinite integrals
- Integrate functions using substitution
- Integrate functions using long division and completing the square

**Core Activities:** Students will complete/participate in the following:

- Daily warm-ups and exit tickets
- Guided and independent practice
- Pair and group practice
- Think-Write-Pair-Share activities
- Student reflection and vocabulary practice in journals
- Peer teaching
- Using alternate methods to solve problems
- Use, select, and discuss solved problems to analyze algebraic reasoning and strategies
- What Can I Say Writing Activity
- Directions for a Friend Activities
- In a class activity, students will use the strategy of error analysis. Written on the white board around the room will be six integration problems broken into stations. Students will visit each station in pairs, discuss what the error is in the integration process, and then redo the problem, correcting the error and agreeing upon their solutions.

**Extensions:** Released AP Free Response Questions

**Remediation:**

- College Board's AP Classroom Progress Checks
- Instructional Videos

**Instructional Methods:**

- Explicit Instruction
- Model use of graphing calculator
- Flipped/Hybrid
- Facilitate discussion and group work

**Materials & Resources:**

- Note-taking guides
- Teacher made handouts/activities
- Graphing Calculators
- Computers
- Journals

**Assessments:**

- Homework Assignments
- Journal entries
- Quizzes
- Tests

## Curriculum Scope & Sequence

**Planned Course:** AP Calculus AB

**Unit:** Differential Equations

**Time frame:** 6 - 8 Blocks

**Anchor(s) or adopted anchor (College Board):** FUN-7.A, FUN-7.B, FUN-7.C, FUN-7.D, FUN-7.E, FUN-7.F, FUN-7.G

**Essential content/objectives:** At end of the unit, students will be able to:

- Modeling Situations with Differential Equations
- Verifying Solutions for Differential Equations
- Sketching Slope Fields
- Reasoning Using Slope Fields
- Finding General Solutions Using Separation of Variables
- Finding Particular Solutions Using Initial Conditions and Separation of Variables
- Exponential Models with Differential Equations

**Core Activities:** Students will complete/participate in the following:

- Daily warm-ups and exit tickets
- Guided and independent practice
- Pair and group practice
- Think-Write-Pair-Share activities
- Student reflection and vocabulary practice in journals
- Peer teaching
- Using alternate methods to solve problems
- Use, select, and discuss solved problems to analyze algebraic reasoning and strategies
- What Can I Say Writing Activity
- Directions for a Friend Activities
- In a class activity, students will write a differential equation to model a given situation. Verbal statements will be associated with mathematical notation; e.g., “the rate of change of  $y$  with respect to  $t$  is proportional to the amount of  $y$ ” would be associated with, “ $dy/dt = Ky$ ”

**Extensions:** Released AP Free Response Questions

**Remediation:**

- College Board’s AP Classroom Progress Checks
- Instructional Videos

**Instructional Methods:**

- Explicit Instruction
- Model use of graphing calculator
- Flipped/Hybrid
- Facilitate discussion and group work

**Materials & Resources:**

- Note-taking guides
- Teacher made handouts/activities
- Graphing Calculators
- Computers
- Journals

**Assessments:**

- Homework Assignments
- Journal entries
- Quizzes
- Tests

## Curriculum Scope & Sequence

**Planned Course:** AP Calculus AB

**Unit:** Applications of Integration

**Time frame:** 6 - 8 Blocks

**Anchor(s) or adopted anchor (College Board):** CHA-4.B, CHA-4.C, CHA-4.D, CHA-4.E, CHA-5.A, CHA-5.B, CHA-5.C

**Essential content/objectives:** At end of the unit, students will be able to:

- Find the Average Value of a Function on an Interval
- Connect Position, Velocity, and Acceleration of Functions Using Integrals
- Use Accumulation Functions and Definite Integrals in Applied Contexts
- Find the Area Between Curves Expressed as Functions of  $x$  and as functions of  $y$
- Find the Area Between Curves That Intersect at More Than Two Points
- Find the volume of solids with known cross-sections
- Find the volume of solids using the disc method revolving around the  $x$ -,  $y$ -, or other axes
- Find the volume of solids using the washer method revolving around the  $x$ -,  $y$ -, or other axes

**Core Activities:** Students will complete/participate in the following:

- Daily warm-ups and exit tickets
- Guided and independent practice
- Pair and group practice
- Think-Write-Pair-Share activities
- Student reflection and vocabulary practice in journals
- Peer teaching
- Using alternate methods to solve problems
- Use, select, and discuss solved problems to analyze algebraic reasoning and strategies
- What Can I Say Writing Activity
- Directions for a Friend Activities
- In a class activity, students will use a flowchart to learn how to set up an integral. In the activity, students will write what functions they are given in the middle of the flowchart and label the units. Working from the middle of the flowchart, students will work upwards, interpreting various integral expressions using units and context; while working downwards, students will interpret derivatives using units and context. Some problems will require the graphing calculator for both derivatives and integrals

**Extensions:**

- Optional student projects to construct solids
- Released AP Free Response Questions

**Remediation:**

- College Board's AP Classroom Progress Checks
- Instructional Videos

**Instructional Methods:**

- Explicit Instruction
- Model use of graphing calculator
- Flipped/Hybrid
- Facilitate discussion and group work

**Materials & Resources:**

- Note-taking guides
- Teacher made handouts/activities
- Graphing Calculators
- Computers
- Journals

**Assessments:**

- Homework Assignments
- Journal entries
- Quizzes
- Tests