

**ROBBINSVILLE PUBLIC SCHOOLS**

**OFFICE OF CURRICULUM AND INSTRUCTION**

**Mathematics Department**  
**AP CALCULUS AB**

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**BOARD OF EDUCATION INITIAL ADOPTION DATE:**

## **Course Philosophy**

Every individual develops an understanding of the concepts of calculus and gains experience with its methods and applications. This understanding and experience is achieved through a multi-representational approach, which emphasizes the relationships between graphical, numerical, analytical, and verbal representations of concepts, problems, and solutions. The connections among the multiple representations of concepts and functions are strengthened by the regular use of technology by students and teacher. Technology also plays a key role in verifying written work and in aiding in the interpretation of experimentation results. Several unifying themes serve to bring cohesion to the course. These themes include derivatives, integrals, limits, approximation, and applications and modeling. They are developed using all of the major mathematical functions with which students are already familiar.

## **Course Description**

The AP Calculus AB course is designed to prepare the students for the Advanced Placement AB test and to give them an opportunity to earn credit for a college level calculus course. The material covered is based on the Advanced Placement Calculus course description. The course will cover all calculus topics ranging from the concepts of limits, derivatives, integration, and all of the applications that apply to each. Students entering this course should have a strong background in geometric concepts and a mastery of the different families of functions. Students should also have an understanding of the language of higher mathematics as applied to functions. The use of a TI-84 is preferred since labs and other activities will be based on this calculator. Since the course is taught at a college level, students should understand that the workload is demanding and expectations are high.

## Integration of 21st Century Themes and Skills

### Educational Technology

**Standards: 8.1.12.A.2, 8.1.12.A.5**

- **Technology Operations and Concepts:** Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
- **Technology Operations and Concepts:** Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.

**Example:** Students can electronically submit a slide presentation on a research topic of their choosing and present it to their peers and teachers. They must include at least 2 tables and 3 graphs in their presentation and use them to help explain their results.

### Career Ready Practices

**Standards: (CRP1, CRP2, CRP4, CRP8, CRP11)**

**CRP1.** Act as a responsible and contributing citizen and employee. Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

**Example:** Students will demonstrate the responsibilities associated with being a member of a community when engaging collaboratively during sharing in pairs/trios, and participating in whole group discussions. Examples may include jigsaw and fishbowl activities, as well as group projects and assessments.

**CRP2.** Apply appropriate academic and technical skills.

**Example:** Students will demonstrate the skills learned in AP Calculus when engaging collaboratively during sharing in pairs/trios, and participating in whole group discussions. Examples may include jigsaw and fishbowl activities, as well as projects and formal assessments.

**CRP4.** Communicate clearly and effectively and with reason. Communication is a key factor in AP Calculus. Students are conscious that their words and techniques they use to convey their thoughts are crucial to audience understanding.

**Example:** Students will demonstrate clear and effective communication through written and oral assignments and assessments.

**CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.

**Example:** Students will demonstrate critical thinking as they determine the best methods to solve free response and multiple choice problems.

**CRP11.** Use technology to enhance productivity.

**Example:** Students will use technology to enhance productivity on a regular basis as they use graphing calculators and other graphing software to complete calculus problems.

### Robbinsville Ready 21st Century Skill Integration

**The following skills will be embedded throughout the curriculum and instruction of this course.**

**Collaborative Team Member:** Robbinsville students will learn more by working together than in isolation. As educational theorist Lev Vygotsky advocated, learning is a social process. Many workplaces today encourage employees to work in teams to solicit diverse perspectives, brainstorm new ideas and/or products, and solve problems. Further, collaboration fosters interpersonal relationships, self-management skills, cooperation, and a sense of collective responsibility. Collaborative team members are able to work with diverse groups of people who hold a variety of perspectives.

**Effective Communicator:** Robbinsville students must be able to clearly articulate their ideas orally, in writing, and across various media in order to successfully connect to the world around them. As the world becomes increasingly globalized, communication is more than just sharing one's ideas. Effective communicators are able to communicate their convictions, actively listen and analyze others' work to identify perspective and/or potential bias.

**Emotionally Intelligent Learner:** Robbinsville students who are emotionally intelligent learn to be empathetic, demonstrate integrity and ethical behavior, are kind, are self-aware, willing to change, and practice self-care. They are better able to cope with the demands of the 21st century digital society and workplace because they are reliable, responsible, form stable and healthy relationships, and seek to grow personally and professionally. Emotionally intelligent people are able to manage their emotions, work effectively on teams and are leaders who can grow and help to develop others.

**Informed and Involved Citizen:** Robbinsville students need to be digital citizens who are civically and globally aware. The concept of what it means to be “literate” has evolved along with 21st century technological and cultural shifts. Our progressive vision of literacy entails having our students explore real world problems in the classroom. Informed and involved citizens are able to safely and accurately communicate with people all around the world and are financially, environmentally and informationally literate.

**Innovative Thinker:** Robbinsville students must encompass innovative thinking skills in order to be successful lifelong learners in the 21st century world. As stated by Karl Fisch and Scott McLeod in the short film Shift Happens, “We are currently preparing students for jobs that don’t yet exist . . . using technologies that haven’t been invented . . . in order to solve problems we don’t even know are problems yet.” Innovative thinkers are able to think analytically, solve problems critically, creatively engage in curiosity and tinkering, and demonstrate originality.

**Resilient and Self-Directed Learner:** Robbinsville students need to take risks and ultimately make independent and informed decisions in an ever-changing world. Author of Life, the Truth, and Being Free, Steve Maraboli stated, “Life doesn’t get easier or more forgiving, we get stronger and more resilient.” Self-directed scholars of the 21st century are able to set goals, initiate resolutions by seeking creative approaches, and adjust their thinking in light of difficult situations. Resilient students are able to take risks without fear of failure and overcome setbacks by utilizing experiences to confront new challenges. Resilient and self directed scholars will consistently embrace opportunities to initiate solutions and overcome obstacles.

### Interdisciplinary Connections

AP Calculus connects widely to the following Career & Technical Education (CTE) Content Area: 21st Century Life and Careers Standards:

**9.3.12.BM-MGT.2 Access, evaluate and disseminate information for business decision making.**

Students will access, evaluate, and disseminate information for decision making on a regular basis as they apply the skills learned in AP Calculus.

**9.3.12.ED.2 Demonstrate effective oral, written and multimedia communication in multiple formats and contexts.**

Students will present oral and multimedia projects to the class in a wide variety of contexts throughout the course. They regularly communicate in writing as they practice AP Free Response questions each unit.

**9.3.12.AG-ENV.4 Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.**

Many mathematical applications of AP Calculus are geared towards environmental phenomena, such as population growth and rates of change of sand, water, and other natural resources.

## General Differentiated Instruction Strategies

<ul style="list-style-type: none"> <li>• Leveled texts</li> <li>• Chunking texts</li> <li>• Choice board</li> <li>• Socratic Seminar</li> <li>• Tiered Instruction</li> <li>• Small group instruction</li> <li>• Guided Reading</li> <li>• Sentence starters/frames</li> <li>• Writing scaffolds</li> <li>• Tangible items/pictures</li> <li>• Adjust length of assignment</li> </ul>	<ul style="list-style-type: none"> <li>• Repeat, reword directions</li> <li>• Brain breaks and movement breaks</li> <li>• Brief and concrete directions</li> <li>• Checklists for tasks</li> <li>• Graphic organizers</li> <li>• Assistive technology (spell check, voice to type)</li> <li>• Study guides</li> <li>• Tiered learning stations</li> <li>• Tiered questioning</li> <li>• Data-driven student partnerships</li> <li>• Extra time</li> </ul>
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### Possible Additional Strategies for Special Education Students, At-Risk Students, and English Language Learners (ELLs)

Time/General	Processing	Comprehension	Recall
<ul style="list-style-type: none"> <li>• Extra time for assigned tasks</li> <li>• Adjust length of assignment</li> <li>• Timeline with due dates for reports and projects</li> <li>• Communication system between home and school</li> <li>• Provide lecture notes/outline</li> </ul>	<ul style="list-style-type: none"> <li>• Extra Response time</li> <li>• Have students verbalize steps</li> <li>• Repeat, clarify or reword directions</li> <li>• Mini-breaks between tasks</li> <li>• Provide a warning for transitions</li> <li>• Reading partners</li> </ul>	<ul style="list-style-type: none"> <li>• Precise step-by-step directions</li> <li>• Short manageable tasks</li> <li>• Brief and concrete directions</li> <li>• Provide immediate feedback</li> <li>• Small group instruction</li> <li>• Emphasize multi-sensory learning</li> </ul>	<ul style="list-style-type: none"> <li>• Teacher-made checklist</li> <li>• Use visual graphic organizers</li> <li>• Reference resources to promote independence</li> <li>• Visual and verbal reminders</li> <li>• Graphic organizers</li> </ul>
Assistive Technology	Assessments and Grading	Behavior/Attention	Organization
<ul style="list-style-type: none"> <li>• Computer/whiteboard</li> <li>• Tape recorder</li> <li>• Spell-checker</li> <li>• Audio-taped books</li> </ul>	<ul style="list-style-type: none"> <li>• Extended time</li> <li>• Study guides</li> <li>• Shortened tests</li> <li>• Read directions aloud</li> </ul>	<ul style="list-style-type: none"> <li>• Consistent daily structured routine</li> <li>• Simple and clear classroom rules</li> <li>• Frequent feedback</li> </ul>	<ul style="list-style-type: none"> <li>• Individual daily planner</li> <li>• Display a written agenda</li> <li>• Note-taking assistance</li> <li>• Color code materials</li> </ul>

## Enrichment

The goal of Enrichment is to provide learners with the opportunity to participate in extension activities that are differentiated and enhance the curriculum. All enrichment decisions will be based upon individual student needs.

- Show a high degree of intellectual, creative and/or artistic ability and demonstrate this ability in multiple ways.
- Pose questions and exhibit sincere curiosity about principles and how things work.
- The ability to grasp concepts and make real world and cross-curricular connections.
- Generate theories and hypotheses and pursue methods of inquiry.
- Produce products that express insight, creativity, and excellence.
- Possess exceptional leadership skills.
- Evaluate vocabulary
- Elevate Text Complexity
- Inquiry based assignments and projects
- Independent student options
- Tiered/Multi-level activities
- Purposeful Learning Center
- Open-ended activities and projects
- Form and build on learning communities
- Providing pupils with experiences outside the 'regular' curriculum
- Altering the pace the student uses to cover regular curriculum in order to explore topics of interest in greater depth/breadth within their own grade level
- A higher quality of work than the norm for the given age group.
- The promotion of a higher level of thinking and making connections.
- The inclusion of additional subject areas and/or activities (cross-curricular).
- Using supplementary materials in addition to the normal range of resources.

# Robbinsville Public Schools

## Curriculum Map

### AP Calculus AB

Relevant Standards	Standards Unpacked Skill / Concept / Process?	Enduring Understandings / Unit Goals	Essential Questions	Unit Title / Suggested Timeline
Unit #1: MP.2 S-ID.7 A-APR.3	Students will study limits of functions and will develop an intuitive understanding of the limiting process, the ability to calculate limits using algebra, and estimate limits from graphs or tables of data	The concept of limit is one of the ideas that distinguish calculus from algebra and trigonometry. One of the uses of limits is to test functions for continuity. <ol style="list-style-type: none"> <li>The student will define and calculate limits of function values.</li> <li>The student will determine the continuity of functions.</li> </ol>	What does it mean for a function to have a limit at a point?  Why are limits important in the study of calculus?  What does it mean for a function to be continuous?  Why is it important to determine if a function is continuous?	Limits and Continuity  (Summer work plus 3 blocks)
Unit #2: MP.5 A-APR.3 F-TF.6-9 S-ID.7	Students will evaluate derivatives of functions, including trigonometric functions and their inverses. Students will use graphs to evaluate derivatives Interpret the slope (rate of change) and the intercept (constant term) of a model in the context of the data.	The derivative gives the instantaneous rate of change of a function. There are simple formulas for calculating derivatives of all types of functions. <ol style="list-style-type: none"> <li>The student will apply differentiation rules to calculate derivatives of various types of functions.</li> </ol>	What does the derivative of a function represent?  How are derivatives calculated using limits?  Is there a way to calculate derivatives that does not involve limits?	Derivatives  (15 blocks)
Unit #3: MP.3 MP.4 MP.5 A-APR.3	-Students will study the analysis of graphs of functions and their derivatives. With the aid of technology, graphs of functions are often easy to produce. The	Derivatives provide information about the general shape of a function's graph.	What information does a derivative reveal about the graph of the original function?	Applications of Derivatives  (15 blocks)



A-REI.1 A-APR.6,7	<p>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</p> <p>-Students will solve related rate and optimization problems including those involving unit pricing and constant speed.</p>	<p>Derivatives are applied to model and solve a variety of real-life problems.</p> <p>Derivatives are used to calculate limits involving indeterminate forms.</p> <ol style="list-style-type: none"> <li>1. The student will find a function given only its first derivative and its value at a single point.</li> <li>2. The student will use derivatives to model and solve real-life application problems.</li> <li>3. The student will use l'Hopital's Rule to calculate limits involving indeterminate forms.</li> </ol>	<p>How are the graphs of the first and second derivative related to the graph of the original function?</p> <p>What types of real-life problems can derivatives be used to solve? How are derivatives applied in these problems?</p> <p>What is a limit of indeterminate form? How can such limits be calculated using derivatives?</p>	
Unit #4: MP.2 MP.5 A-APR.3 A-APR.6 A-APR.7	<p>-Use algebraic techniques to integrate functions, including long division and partial fractions</p> <p>-Use graphs to evaluate a definite integral</p>	<p>The integral describes how instantaneous changes accumulate over an interval to produce a function.</p> <p>Derivatives and integrals are closely related through the Fundamental Theorem of Calculus.</p> <ol style="list-style-type: none"> <li>1. The student will calculate integrals using the rules of integration and a graphing calculator.</li> </ol>	<p>What does a definite integral represent?</p> <p>What are several methods of calculating a definite integral?</p> <p>What is the connection between derivatives and integrals?</p>	<p>The Definite Integral</p> <p>(10 blocks)</p>
Unit #5: MP.4 MP.5 A-APR.3 A-APR.6 A-APR.7 F-IF.5	<p>-Students will study the analysis of graphs of slope fields and differential equations. 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.</p>	<p>There are several methods for integrating functions for which there is no rule of integration.</p> <p>Differential equations are used to model various real-life situations and make predictions about future behavior.</p> <ol style="list-style-type: none"> <li>1. The student will use various integration methods to solve problems involving differential equations.</li> </ol>	<p>How can a function be integrated if there are no rules of integration that apply to the function?</p> <p>What is a differential equation? How are differential equations related to problems involving growth and decay?</p>	<p>Differential Equations and Mathematical Modeling</p> <p>(8 blocks)</p>

Unit #6: MP.3 MP.4 MP.5 A-APR.3 S-ID.7 G-GMD.1-4 A-REI.1	-Use graphs and functions to determine rate and amount of quantities of real-world problems -Interpret the slope (rate of change) and the intercept (constant term) of a model in the context of the data given a real-world problem -Explain volume formulas and use them to solve problems	Integrals can be applied to model and solve a wide variety of mathematical and real-life problems. 1. The student will solve problems by setting up an appropriate function and integrating it.	For what types of problems can integrals be used to model and solve the problems?	Applications of Definite Integrals  (12 blocks)
Unit #7: MP.1 MP.2 MP.3 MP.5 MP.6		Mastery of all topics from AP Calc AB is necessary for success on the AP Exam 1. Students will complete practice tests in groups and individually 2. Students will review topics by unit 3. Students will do practice problems in which they must incorporate several topics at once and determine the best method for solving	What can I do to prepare for the AP Exam?  How can I determine the best methods for solving a problem?	Review for AP Exam  (18 blocks)
Unit #8: MP.4 MP.5		Topics learned throughout the course can be used in fun and creative ways in real-world situations. 1. Students will complete two projects and/or presentations on various topics in AP Calculus.	How can I apply what I learned in Calculus to the real world?	Post-AP Exam Projects  (8 blocks)

**Robbinsville Public Schools**  
**Scope, Sequence, Pacing and Assessment**

**AP Calculus BC**

Unit Title	Unit Understandings and Goals	Recommended Duration/ Pacing	Benchmark Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
Unit #1: Limits and Continuity	<p>The concept of limit is one of the ideas that distinguish calculus from algebra and trigonometry.</p> <p>One of the uses of limits is to test functions for continuity.</p> <ol style="list-style-type: none"> <li>The student will define and calculate limits of function values.</li> <li>The student will determine the continuity of functions.</li> </ol>	Summer work plus 3 blocks	<p>Summer Assignment</p> <p>Oral Questions/ Discussion</p> <p>Entrance Slips</p>	<p>Chapter Test</p> <p>Exit Slips</p> <p>Observations</p>	AP Test
Unit # 2: Derivatives	<p>The derivative gives the instantaneous rate of change of a function.</p> <p>There are simple formulas for calculating derivatives of all types of functions.</p> <ol style="list-style-type: none"> <li>The student will apply differentiation rules to calculate derivatives of various types of functions.</li> </ol>	15 blocks	<p>Oral Questions/ Discussion</p> <p>Entrance Slips</p> <p>Student Survey</p>	<p>Written Assignments</p> <p>Oral Presentations</p> <p>Observations</p> <p>Exit Slips</p> <p>Quizzes</p> <p>Chapter Test</p>	AP Test
Unit #3: Applications of Derivatives	<p>Derivatives provide information about the general shape of a function's graph.</p> <p>Derivatives are applied to model and solve a variety of real-life problems.</p> <p>Derivatives are used to calculate limits involving indeterminate forms.</p> <ol style="list-style-type: none"> <li>The student will find a function given only its first derivative and its value at a single point.</li> </ol>	15 blocks	<p>Oral Questions/ Discussion</p> <p>Entrance Slips</p> <p>Student Survey</p>	<p>Written Assignments</p> <p>Oral Presentations</p> <p>Observations</p> <p>Exit Slips</p> <p>Quizzes</p> <p>Chapter Test</p>	AP Test

	<ol style="list-style-type: none"> <li>The student will use derivatives to model and solve real-life application problems.</li> <li>The student will use l'Hopital's Rule to calculate limits involving indeterminate forms.</li> </ol>				
Unit #4: The Definite Integral	<p>The integral describes how instantaneous changes accumulate over an interval to produce a function. Derivatives and integrals are closely related through the Fundamental Theorem of Calculus.</p> <ol style="list-style-type: none"> <li>The student will calculate integrals using the rules of integration and a graphing calculator.</li> </ol>	10 blocks	<p>Oral Questions/ Discussion</p> <p>Entrance Slips</p> <p>Student Survey</p>	<p>Written Assignments</p> <p>Oral Presentations</p> <p>Observations</p> <p>Exit Slips</p> <p>Quizzes</p> <p>Chapter Test</p>	AP Test
Unit #5: Differential Equations and Mathematical Modeling	<p>There are several methods for integrating functions for which there is no rule of integration. Differential equations are used to model various real-life situations and make predictions about future behavior.</p> <ol style="list-style-type: none"> <li>The student will use various integration methods to solve problems involving differential equations.</li> </ol>	8 blocks	<p>Oral Questions/ Discussion</p> <p>Entrance Slips</p> <p>Student Survey</p>	<p>Written Assignments</p> <p>Oral Presentations</p> <p>Observations</p> <p>Exit Slips</p> <p>Quizzes</p> <p>Chapter Test</p>	AP Test
Unit #6: Applications of the Definite Integral	<p>Integrals can be applied to model and solve a wide variety of mathematical and real-life problems.</p> <ol style="list-style-type: none"> <li>The student will solve problems by setting up an appropriate function and integrating it.</li> </ol>	12 blocks	<p>Oral Questions/ Discussion</p> <p>Entrance Slips</p> <p>Student Survey</p>	<p>Written Assignments</p> <p>Oral Presentations</p> <p>Observations</p> <p>Exit Slips</p> <p>Quizzes</p> <p>Chapter Test</p>	AP Test

Unit #7: Review for AP Exam	Mastery of all topics from AP Calc BC is necessary for success on the AP Exam <ol style="list-style-type: none"> <li>Students will complete practice tests in groups and individually</li> <li>Students will review topics by unit</li> <li>Students will do practice problems in which they must incorporate several topics at once and determine the best method for solving</li> </ol>	18 blocks	Oral Questions/ Discussion  Entrance Slips  Student Survey	Written Assignments  Oral Presentations  Observations  Participatory Rubrics  Quizzes  Exit Slips	AP Test
Unit #8: Post-AP Exam Work	Topics learned throughout the course can be used in fun and creative ways in real-world situations. <ol style="list-style-type: none"> <li>Students will complete two projects and/or presentations on various topics in AP Calculus</li> </ol>	8 blocks	Oral Questions/ Discussion  Student Survey	Written Assignments  Oral Presentations  Observations  Participatory Rubrics	Projects  Final Exam  End-of-Year course evaluation

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## Unit #1: Limits and Continuity

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>The concept of limit is one of the ideas that distinguish calculus from algebra and trigonometry.</li> <li>One of the uses of limits is to test functions for continuity.</li> </ul>	<b>Essential Questions:</b> <ul style="list-style-type: none"> <li>What does it mean for a function to have a limit at a point?</li> <li>Why are limits important in the study of calculus?</li> <li>What does it mean for a function to be continuous?</li> <li>Why is it important to determine if a function is continuous?</li> </ul>
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**Duration of Unit:** Summer work plus 3 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MP.2	What does the limit of a function represent? What are the various methods used for calculating limits of functions?	Calculate limits and apply the properties of limits.	Complete the summer assignment  Class discussion in review of summer assignment	Textbooks  Summer assignment packet  Summer assignment answer packet  Graphing calculators	Class participation  Homework / written assignments  Student solutions to summer assignment problems  Written test
A-AP R.3	What is a continuous function? How can a function be modified to remove discontinuities? What is the connection between limits and continuity?	Identify continuous functions and intervals of continuity.			
S-ID.7	How is the average rate of change of a function related to the slope of the curve?	Find the average rate of change of a function.			
S-ID.7	How can the slope of the curve be used to find the equation of the tangent line to the curve? How are the slope of the curve and the equation of the tangent line related to limits?	Find the slope of a curve and the equation of the tangent line to a curve.			

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## Unit #2: Derivatives

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>The derivative gives the instantaneous rate of change of a function.</li> <li>There are simple formulas for calculating derivatives of all types of functions.</li> </ul>	<b>Essential Questions</b> <ul style="list-style-type: none"> <li>What does the derivative of a function represent?</li> <li>How are derivatives calculated using limits?</li> <li>Is there a way to calculate derivatives that does not involve limits?</li> <li>How can derivatives be applied to solve real-life problems?</li> </ul>
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**Duration of Unit:** 15 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
F-TF.6 -9 S-ID.7 A-AP R.3	How does the derivative relate to limits and slope? What causes a function to not be differentiable?	Find where a function is not differentiable.	Direct instruction  Class discussion (question and answer)  Discovery learning	Textbooks  Graphing calculators  www.illuminations.nctm.org	Written test / quiz  Cooperative activities (rubrics)  Notebooks
A-AP R.3	What are the rules of differentiation? When is it necessary to use the Chain Rule? When is it necessary to use Implicit Differentiation?	Use the rules of differentiation to calculate derivatives of various types of functions.	Cooperative learning  Investigations  Use of instructional media	<a href="http://www.apcentral.collegeboard.com">www.apcentral.collegeboard.com</a>  www.desmos.com	Class participation  Homework / written assignments
S-ID.7	How is the derivative related to rates of change? How can the derivative be used to solve problems involving rates of change?	Use derivatives to solve problems involving rates of change.	Computer tutorials		

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## Unit #3: Applications of Derivatives

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>Derivatives provide information about the general shape of a function's graph.</li> <li>Derivatives are applied to model and solve a variety of real-life problems.</li> </ul>	<b>Essential Questions</b> <ul style="list-style-type: none"> <li>What information does a derivative reveal about the graph of the original function?</li> <li>How are the graphs of the first and second derivative related to the graph of the original function?</li> <li>What types of real-life problems can derivatives be used to solve?</li> <li>How are derivatives applied in these problems?</li> </ul>
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**Duration of Unit:** 15 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
A-AP R.3	What is the First Derivative Test? What is the Second Derivative Test? What information do the first and second derivatives give about the original function?	Determine extreme values of a function.  Find the intervals on which a function increases or decreases.  Find the concavity of a function and the points of inflection.	Direct instruction  Class discussion (question and answer)  Discovery learning  Cooperative learning	Textbooks  Graphing calculators  www.illuminations.nctm.org  <a href="http://www.apcentral.collegeboard.com">www.apcentral.collegeboard.com</a>  www.desmos.com	Written test / quiz  Cooperative activities (rubrics)  Notebooks  Class participation  Homework / written assignments  Oral presentations  Special projects
MP.4	How are derivatives used to solve real-life problems involving maximum and minimum values? What strategies can be used to solve such problems?	Solve application problems involving minimum and maximum values. A-APR.6,7	Investigations		
MP.5 A-REI .1	How are derivatives used to solve real-life problems involving related rates? What strategies can be used to solve such problems?	Solve related rates problems.	Use of instructional media		
A-AP R.6,7	What is l'Hopital's Rule? How can it be used to find the limits of indeterminate forms? How can it be used to compare the rates of growth of functions?	Find limits of indeterminate forms using l'Hopital's Rule.  Use l'Hopital's Rule to compare the rates of growth of functions.	Computer tutorials		



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## Unit #4: The Definite Integral

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>The integral describes how instantaneous changes accumulate over an interval to produce a function.</li> <li>Derivatives and integrals are closely related through the Fundamental Theorem of Calculus.</li> </ul>	<b>Essential Questions:</b> <ul style="list-style-type: none"> <li>What does a definite integral represent?</li> <li>What are several methods of calculating a definite integral?</li> <li>What is the connection between derivatives and integrals?</li> </ul>
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**Duration of Unit:** 10 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MP.4 A-AP R.3	What are the several methods for approximating the area under the graph of a function? How are they similar? How are they different?	Approximate the area under the graph of a function.	Direct instruction  Class discussion (question and answer)  Discovery learning  Cooperative learning	Textbooks  Graphing calculators  www.illuminations.nctm.org  <a href="http://www.apcentral.collegeboard.com">www.apcentral.collegeboard.com</a>	Written test / quiz  Cooperative activities (rubrics)  Notebooks  Class participation
A-AP R.6	What is a definite integral? How is it related to limits? How can it be used to calculate the area under a curve?	Express the area under the curve as a definite integral.	Investigations  Use of instructional media  Computer tutorials	www.desmos.com	Homework / written assignments  Oral presentations  Special projects
A-AP R.7	How can definite integrals be calculated numerically? How can they be calculated analytically? Which method is more precise?	Calculate definite integrals numerically and by applying rules for integrals.			
MP.2	How is the definite integral related to the derivative? How is this connection applied to calculate the value of a definite integral analytically?	Apply the Fundamental Theorem of Calculus.			

### Unit #5: Differential Equations and Mathematical Modeling

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>There are several methods for integrating functions for which there is no rule of integration.</li> <li>Differential equations are used to model various real-life situations and make predictions about future behavior.</li> </ul>	<b>Essential Questions:</b> <ul style="list-style-type: none"> <li>How can a function be integrated if there are no rules of integration that apply to the function?</li> <li>What is a differential equation?</li> <li>How are differential equations related to problems involving growth and decay?</li> </ul>
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**Duration of Unit:** 8 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
A-AP R.3 MP.4 F-IF.5	How do you solve an initial value problem? How does Euler's Method help you to graph the solution to an initial value problem?	Solve initial value problems.	Direct instruction  Class discussion (question and answer)  Discovery learning	Textbooks  Graphing calculators  www.illuminations.nctm.org	Written test / quiz  Cooperative activities (rubrics)  Notebooks
A-AP R.6,7	What is the substitution method for evaluating integrals? When is it necessary to use the substitution method?	Compute definite and indefinite integrals by substitution.	Cooperative learning  Investigations	<a href="http://www.apcentral.collegeboard.com">www.apcentral.collegeboard.com</a>	Class participation
A-AP R.3 MP.5	What is a separable differential equation? How is a separable differential equation solved? How does this apply to problems involving exponential growth and decay?	Solve problems involving exponential growth and decay.	Use of instructional media  Computer tutorials	www.desmos.com	Homework / written assignments  Oral presentations  Special projects

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## Unit #6: Applications of Definite Integrals

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>Integrals can be applied to model and solve a wide variety of mathematical and real-life problems.</li> </ul>	<b>Essential Questions:</b> <ul style="list-style-type: none"> <li>For what types of problems can integrals be used to model and solve the problems?</li> </ul>
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**Duration of Unit:** 12 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
A-REI .1 A-AP R.3 S-ID.7	How can integration be applied to a rate to determine net change over time?	Use integration to find net change over time.	Direct instruction  Class discussion (question and answer)  Discovery learning	Textbooks  Graphing calculators  www.illuminations.nctm.org	Written test / quiz  Cooperative activities (rubrics)  Notebooks
MP.4	How can integration be applied to calculate the area of a region in a plane?	Use integration to calculate areas of regions in a plane.	Cooperative learning  Investigations	<a href="http://www.apcentral.collegeboard.com">www.apcentral.collegeboard.com</a>	Class participation
MP.4 G-GM D.1-4	How can integration be applied to calculate the volume and surface area of a solid?	Use integration to calculate volumes and surface areas of solids.	Use of instructional media  Computer tutorials	www.desmos.com	Homework / written assignments  Oral presentations  Special projects
MP.5	How can integration be applied to calculate the length of a curve in a plane?	Use integration to calculate lengths of curves in a plane.			

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## Unit #7: Review for AP Exam

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>A deep understanding of differentiable &amp; integral calculus and their applications is crucial to a successful AP Exam.</li> </ul>	<b>Essential Questions:</b> <ul style="list-style-type: none"> <li>What can I do to prepare for the AP Exam?</li> </ul>
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**Duration of Unit:** 18 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MP.1 MP.5	How can I determine the best methods for solving a problem?	Review all topics from the curriculum	Direct instruction (review)  Class discussion (question and answer)  Discovery learning	Textbooks  Graphing calculators  www.illuminations.nctm.org	Partner/group quizzes  Practice Tests  Cooperative activities (rubrics)
MP.6	What is the best strategy for multiple choice problems?	Take practice tests	Cooperative learning  Investigations  Use of instructional media	<a href="http://www.apcentral.collegeboard.com">www.apcentral.collegeboard.com</a>  www.desmos.com	Notebooks  Class participation  Homework / written assignments
MP.2 MP.3	How can I make sure I explain my work correctly and thoroughly on the free response section?	Complete previous years' free response problems	Computer tutorials  Afterschool and Evening Review Sessions	Previous AP Exams  AP Review Books	Oral presentations  Special projects

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## Unit #8: Post-AP Exam Work

<b>Enduring Understandings:</b> <ul style="list-style-type: none"> <li>Calculus is all around us</li> </ul>	<b>Essential Questions: :</b> <ul style="list-style-type: none"> <li>Where is calculus found in the real world?</li> </ul>
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**Duration of Unit:** 8 blocks

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MP.4 MP.5	How can I apply what I learned in Calculus to the real world?	Choose two projects to complete that use single-variable calculus in real-world situations. Examples include: <ol style="list-style-type: none"> <li>“Cooking with Calculus”: Students rewrite numbers in a recipe using expressions and equations from the course</li> <li>Volume Model Project: Students use integrals to express the volume of a solid, then construct the actual solid out of any material they like</li> <li>Research Project: Students choose a topic in math (like Math in Football or Counting Cards) and write a research paper, then give a presentation to the class</li> <li>Flashcards: Students make flashcards or a matching game about a topic from calculus for future AP Calc students to use to study</li> </ol>	Student-directed research  Independent study/work time  Group work	Desmos.com  Online resources  All worksheets/tests from the year  Textbooks  Graphing Calculators	Project  Final Exam

## English Language Learner (ELL) Resources

- Learning style quiz for students- <http://www.educationplanner.org/students/self-assessments/learning-styles-quiz.shtml>
- “Word clouds” from text that you provide-<http://www.wordle.net/>
- Bilingual website for students, parents and educators: <http://www.colorincolorado.org/>
- Learn a language for FREE-[www.Duolingo.com](http://www.Duolingo.com)
- Time on task for students-<http://www.online-stopwatch.com/>
- Differentiation activities for students based on their Lexile-[www.Mobymax.com](http://www.Mobymax.com)
- WIDA-<http://www.wida.us/>
- Everything ESL - <http://www.everythingESL.net>
- ELL Tool Box Suggestion Site<http://www.wallwisher.com/wall/elltoolbox>
- Hope4Education - <http://www.hope4education.com>
- Learning the Language <http://blogs.edweek.org/edweek/learning-the-language/>
- FLENJ (Foreign Language Educators of NJ) 'E-Verse' wiki: <http://www.flenj.org/Publications/?page=135>
- OELA - <http://www.ed.gov/offices/OBEMLA>
- New Jersey Department of Education- Bilingual Education information <http://www.state.nj.us/education/bilingual/>

## Special Education Resources

- Animoto -Animoto provides tools for making videos by using animation to pull together a series of images and combining with audio. Animoto videos or presentations are easy to publish and share. <https://animoto.com>
- Bookbuilder -Use this site to create, share, publish, and read digital books that engage and support diverse learners according to their individual needs, interests, and skills. <http://bookbuilder.cast.org/>
- CAST -CAST is a non-profit research and development organization dedicated to Universal Design for Learning (UDL). UDL research demonstrates that the challenge of diversity can and must be met by making curriculum flexible and responsive to learner differences. <http://www.cast.org>
- CoSketch -CoSketch is a multi-user online whiteboard designed to give you the ability to quickly visualize and share your ideas as images. <http://www.cosketch.com/>
- Crayon -The Crayon.net site offers an electronic template for students to create their own newspapers. The site allows you to bring multiple sources together, thus creating an individualized and customized newspaper. <http://crayon.net/> Education Oasis -Education Oasis offers a collection of graphic organizers to help students organize and retain knowledge – cause and effect, character and story, compare and contrast, and more! <http://www.educationoasis.com/printables/graphic-organizers/>

- Edutopia -A comprehensive website and online community that increases knowledge, sharing, and adoption of what works in K-12 education. We emphasize core strategies: project-based learning, comprehensive assessment, integrated studies, social and emotional learning, educational leadership and teacher development, and technology integration. <http://www.edutopia.org/>
- Glogster -Glogster allows you to create "interactive posters" to communicate ideas. Students can embedded media links, sound, and video, and then share their posters with friends. <http://edu.glogster.com/?ref=personal>
- Interactives – Elements of a Story -This interactive breaks down the important elements of a story. Students go through the series of steps for constructing a story including: Setting, Characters, Sequence, Exposition, Conflict, Climax, and Resolution. <http://www.learner.org/interactives/story/index.html>
- National Writing Project (NWP) -Unique in breadth and scale, the NWP is a network of sites anchored at colleges and universities and serving teachers across disciplines and at all levels, early childhood through university. We provide professional development, develop resources, generate research, and act on knowledge to improve the teaching of writing and learning in schools and communities. <http://www.nwp.org>
- Pacecar -Vocab Ahead offers videos that give an active demonstration of vocabulary with audio repeating the pronunciation, definition, various uses, and synonyms. Students can also go through flash cards which give a written definition and visual representation of the word. <http://pacecar.missingmethod.com/>