Bloomfield Public Schools
Bloomfield, New Jersey

Curriculum guide

AP Calculus BC
Grade 12

Prepared by:
Brian Miller

Nicholas J. Dotoli, Interim Superintendent of Schools
Dr. Gary J. Vitta, Interim Director of Instruction
Roger Marchegiano, Supervisor of Mathematics K-12

Originally Board Approved: July 30, 2013

Standards Revision: Updated by Kevin Agnew

Conforms to the New Jersey Student Learning Standards

Board Approved: August 22, 2017

Title of Unit	Unit #1: Limits and Continuity	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	9 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
A-APR.6 Rewrite rational expressions
F-BF.1-4 Build a function that models a relationship between two quantities, Function transformations
G-MG1-3 Apply geometric methods in modeling situations
F-IF.6 Rate of change
F-IF 1 – 3 Understand the concept of a function and use function notation.
F-IF 7 Analyze functions using different representations

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.
9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.
9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.
9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…
T1. Communicate about ideas of limits in a standard and understandable manner.
T2. Students will relate the topics learned about limits to things that they do in their everyday lives.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Calculus is the study of change. U2. Patterns can continue to infinity and yet still have a limit as to how big they can get. U3. The behavior of a function as its independent variable approaches a certain value is not necessarily the same as the value of a function when the independent variable reaches that value.	Q1. How is it possible to find the slope of a tangent line? Q2. How are algebraic, graphical, numerical, and contextual representations of values related? Q3. What does it mean for a function to be continuous?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. What it means for the value of a function to be undefined K2. What it means for a function's limit to be "DNE" K3. What it means when a function is not continuous	S1. Find the limit of a function numerically, graphically, and analytically S2. Determine when a function is continuous (formally) S3. Determine where and what type of discontinuity a function has (if any) S4. Determine the end behavior of a function S5. Find the instantaneous rate of change of a function and connect it with the slope of the tangent line S6. Use epsilon-delta definition to show a limit exists or does not exist in linear situations S7. Construct sign charts to determine the behavior (sign) of a function over different intervals.

<table>
<tr><th colspan="3">Evidence (Stage 2)</th></tr>
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Performance is judged in terms of…</th><th><u>Assessment Evidence</u></th></tr>
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Rubric</td><td><u>Transfer Task(s)</u>
Formative
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Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Flip Introduction: Students view online videos that explain and demonstrate the concept of limits and then develop class notes, practice, and quiz in class	Text: Single Variable Calculus
	The Calculus Problem Book: Problems 93-312	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	The Calculus Problem Book: Sample AP Calculus Test One	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Barron's: Limits and Continuity Review Material (*Done later in the year for AP prep *)	GeoGebra Software. From http://www.geogebra.org
		Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	Read Online Calculus Text, Limits Chapter	Internet
	TI Lab #1	Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:

- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks

- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points
- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #2: The Derivative	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	8 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE 1- 2 Interpret the structure of expressions
F-BF.1 Build a function that models a relationship between two quantities
N-RN.1-3. Extend the properties of exponents to rational exponents

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.
9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.
9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.
9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…
T1. Communicate about ideas in of the derivative in a standard and understandable manner.
T2. Students will relate the topics learned about the derivative and instantaneous slope to things that they do in their everyday lives.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	**Students will keep considering…**
U1. There is a numeric, algebraic, and graphical relationship between a function and its derivative.	Q1. How the limit of the average rate of change can be used to represent instantaneous rate of change? Q2. When does a function have a derivative and when does it not? Q3. How does the slope of the graph of a function relate to the graph of its derivative?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. The relationship between limits, continuity, and differentiability. K2. The acceptable mathematical notations to represent the derivative.	S1. Match graphs of functions with their derivatives S2. Evaluate the limit of the average rate of change to find the derivative. S3. Represent the derivative at a point as a limit of a difference function. S4. Explain the meaning of the derivative graphically as well as in the context of an application. S5. Determine if a function is differentiable at a point and if not why.

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Learning Plan (Stage 3)

Checks for alignment and best practice	Summary of Key Learning Events and Instruction *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Flipped Introduction: Students view online videos that introduce the concept of the derivative and then develop class notes, practice, and quiz in class.	Text: Single Variable Calculus
	Graph Derivative Puzzle: Students create 3x3 derivative puzzles for classmates to solve.	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	GeoGebra Derivative Exploration Applet	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Online Calculus Text Derivative Chapter Sections 1, 2, and 3 exercises and assignments	GeoGebra Software. From http://www.geogebra.org
	Barron's: Chapter Differentiation A, D, E, and K (*Done later in the year for AP prep *)	Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	http://www.calculus-help.com/tutorials Chap 2, Lesson 1	Internet
	The Human Graph, using yarn, the students collaborate to create a visual representation of an antiderivative given a function.	Mathematics Library
	Calculus Lab #4	Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
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STUDENTS BELOW TARGET:

- Pretest students to assess key pre-skills and background knowledge
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- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points

- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #3: Differentiation Techniques	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	14 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
A-APR.6 Rewrite rational expressions
F-BF.1 Build a function that models a relationship between two quantities
F-IF.1-9: Analyze functions using different representations

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
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9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Communicate about differentiation algorithms with one another in an understandable manner.
T2. Students will apply various differentiation techniques to appropriate differentiation problems.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. The importance of the techniques of differentiation for other studies in calculus. U2. The form of the function dictates the appropriate algorithm to determine the derivative.	Q1. What characteristics of a function are required for each differentiation algorithm? Q2. How the algebraic representation of a derivative does relates to its function?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. Multiple techniques of differentiation and how to identify the appropriate situations for each.	S1. Evaluate a derivative using the sum and difference rule. S2. Evaluate a derivative using the constant rule. S3. Evaluate a derivative using the power rule. S4. Evaluate a derivative using the product rule. S5. Evaluate a derivative using the quotient rule. S6. Evaluate a derivative using the chain rule. S7. Evaluate a derivative using the log rules. S8. Evaluate a derivative using the exponential rules. S9. Evaluate a derivative using the implicit rule. S10. Evaluate a derivative using the trig rules. S11. Evaluate a derivative using the inverse rules.

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Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Calculus Problem Books: problems 332-521, 556-642	Text: Single Variable Calculus
	Calculus Problem Book Sample AP Test Two	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	Barron's: Chapter Differentiation B, C, G, H, and I (*Done later in the year for AP prep *)	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Flipped Lessons for Power, Product, Quotient, and Chain Rules	GeoGebra Software. From http://www.geogebra.org
		Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	Read Online Calculus Text: Chapter Derivatives (except Hyperbolic Trig and Related Rates)	Internet
	TI Lab #2	Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
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Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:

- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points

- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #4: Antiderivative	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	8 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

F –BF.3 Function transformations
F-BF.4 Find inverse functions
F-IF.1-9: Analyze functions using different representations
G-MG1-3 Apply geometric methods in modeling situations

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
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21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Communicate about the antiderivative in a standard and understandable manner.
T2. Students will relate the antiderivative to content outside of the calculus classroom.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Mathematical operations have inverses. U2. Antiderivatives have an infinite number of solutions.	Q1. How can particular solutions be generated from general solutions? Q2. How can each derivative rule be reversed? Q3. What attributes does the graph of the antiderivative have given the graph of an expression?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. The meaning of expressions generated through the antiderivative.	S1. Compute the antiderivative of expressions generated from basic differentiation techniques. S2. Solve for constants of integration. S3. Sketch graphs of the antiderivative given graphs of an expression.

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	Required Activities	**Required Resources**
	Flipped Introduction: Students watch online video introducing the concept and then develop class notes, practice, and quiz in class.	Text: Single Variable Calculus
	Calculus Problem Book: problems 835-878	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	Geogebra: Antiderivative Explorer Applet	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Barron's: Antidifferentiation A, B (*Done later in the year for AP prep *)	GeoGebra Software. From http://www.geogebra.org
		Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	The Human Graph, using yarn, the students collaborate to create a visual representation of an antiderivative given a function.	Internet
		Mathematics Library
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- Pretest students to assess key pre-skills and background knowledge
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- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #5: The Definite Integral	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	6 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

F –BF.3 Function transformations
F-BF.4 Find inverse functions
G-MG1-3 Apply geometric methods in modeling situations
N-Q.1-3 Reason quantitatively and use units to solve problems

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.
9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.
9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.
9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Communicate about the meaning of the definite integral in a standard and understandable manner.
T2. Students will relate the topics learned about the definite integral relate to previously learned calculus and content outside of calculus.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Integration is related to integration through the Fundamental Theorem of Calculus. U2. The area of an infinite number of infinitesimally wide rectangles can be used to exactly determine the area number any continuous curve.	Q1. What is the integral notation? Q2. What is the meaning of the integral? Q3. How do you find the definite integral?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. The integral represents the sum of an infinite amount of quantities.	S1. Find the value of integral numerically and as an expression. S2. Find the area of a given region given the equations and the boundaries. S3. Use various geometric shapes to approximate the integral from graphs.

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• Application
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• Evaluation
Rubric</td><td><u>Transfer Task(s)</u>
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<tr><td>Summative
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• Informal Observations</td></tr>
</table>

Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Geogebra: Area of Geometric Shapes Applet	Text: Single Variable Calculus
	Geogebra: Riemann Sums Applet	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	Calculus Problem Book problems 911-923, 953-981, 1029-1051	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Barron's: Definite Integral A, B, and E (*Done later in the year for AP prep *)	GeoGebra Software. From http://www.geogebra.org
		Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	Calculus Lab #5	Internet
		Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:

- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points

- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #6: Integration Techniques	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	20 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
A-APR.6 Rewrite rational expressions
F-IF.1-9: Analyze functions using different representations
F –BF.3 Function transformations
F-BF.4 Find inverse functions
G-MG1-3 Apply geometric methods in modeling situations
N-Q.1-3 Reason quantitatively and use units to solve problems

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.
9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.
9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.
9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Communicate about integration techniques with one another in a standard and understandable manner.
T2. Analyze real life situations in a mathematical way.
T3. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. The importance of the techniques of differentiation for other studies in calculus. U2. The form of the function dictates the appropriate algorithm to determine the derivative.	Q1. What characteristics of a function are required for each integration algorithm? Q2. How the algebraic representation of an integral relate to its function?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. Algebraic procedures that can transform an integral that cannot be evaluated into one that can be evaluated.	S1. Integration following from derivatives of basic functions S2. Integration by substitution S3. Change of limits for definite integrals S4. Integration by parts S5. Integration using partial fractions S6. Using tables of integrals S7. Approximating definite integrals represented algebraically, graphically, and by tables of values S8. Riemann sums (left, right, midpoint) S9. Trapezoidal sums S10. Simpson's Rule S11. Errors in approximations including graphical interpretation S12. Improper integrals S13. Convergence and divergence S14. Graphical interpretation S15. Evaluating improper integrals as limits of definite integrals S16. Comparing improper integrals – comparison tests

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• Application
• Analysis
• Synthesis
• Evaluation
Rubric</td><td><u>Transfer Task(s)</u>
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<tr><td>Summative
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• Test
• Project</td></tr>
<tr><td rowspan="2">K1, S1-16</td><td rowspan="2">Blooms Taxonomy
• Knowledge
• Comprehension
• Application
• Analysis
• Synthesis
• Evaluation
Rubric</td><td><u>Other Evidence</u>
Formative
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<tr><td>Summative
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• Informal Observations</td></tr>
</table>

Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Calculus Problem Book: 879-910, 982-1013, 1055-1072, 1076-1089, 1243-1289, 1330-1367	Text: Single Variable Calculus
	Calculus Problem Book Practice AP Tests Four and Five (reduced in size and combined).	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	Students develop online wiki of all the integration techniques.	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Barron's: Antidifferentiation C and D (*Done later in the year for AP prep *)	GeoGebra Software. From http://www.geogebra.org
	Flipped Video Lessons for each of the different integration techniques.	Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	Read Online Text: Calculus I – Integration and Calculus II – Integration Techniques (appropriate sections)	Internet
	TI Labs #4, #5, and #6	Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:

- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points

- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #7: Using the Derivative	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	20 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
F-BF.1 Build a function that models a relationship between two quantities
G-MG1-3 Apply geometric methods in modeling situations
F-IF.1-9: Analyze functions using different representations
N-Q.1-3 Reason quantitatively and use units to solve problems

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.
9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.
9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.
9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…
T1. Communicate about calculus ideas in the context of applications.
T2. Analyze real life situations in a mathematical way.
T3. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. The derivative is essential for answer any question involving changing values.	Q1. How do changing variables relate to one another? Q2. How does position, velocity, and acceleration relate to one another? Q3. How does absolute differ from relative motion?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. What mathematical theorems relate to continuity and differentiability. K2. The difference between local and absolute extreme.	S1. Apply mathematical theorems. S2. Solve for critical values and points of inflection. S3. Setup and solve optimization problems. S4. Relate derivatives and antiderivatives to motion problems.

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<tr><td rowspan="2">K1, 2, S1-4</td><td rowspan="2">Blooms Taxonomy
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</table>

Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Flipped Introduction to each application: Displacement / Velocity / Acceleration, Related Rates, and Optimization	Text: Single Variable Calculus
	Students develop online website/wiki for the calculus theorems.	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	Calculus Problem Book: problems 537-555, 676-718, 722-808	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Calculus Problem Book Practice AP Test Three (with some questions from test two)	GeoGebra Software. From http://www.geogebra.org
	Barron's: Applications of Calculus (*Done later in the year for AP prep *)	Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	Read Online Text : Application of Derivatives (appropriate sections)	Internet
	Create class displays with examples of each type of application.	Mathematics Library
	Calculus Labs #1 and #2	Mathematics Lab
	TI Lab #3	College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
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Visual Cues Found on Worksheets	Teach Organizational Skills
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STUDENTS BELOW TARGET:

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- Provide different demonstrations or models
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- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points

- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #8: Using the Integral	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	15 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
F-BF.1 Build a function that models a relationship between two quantities
G-MG1-3 Apply geometric methods in modeling situations
F-IF.1-9: Analyze functions using different representations
N-Q.1-3 Reason quantitatively and use units to solve problems

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
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9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.
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21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…
T1. Communicate about calculus ideas in the context of applications
T2. Analyze real life situations in a mathematical way.
T3. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. The integral is essential to answering any real world question that relates to infinite sums.	Q1. How the integral can be applied to area and volume problems?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. The geometric representation of integral expressions.	S1. Find the area between curves S2. Find the volume of solids given cross sections S3. Find the volume of solids of rotation (disc method) S4. Find the volume of solids of rotation (shell method) S5. Find the arc length of irregular curves. S6. Find the density and center of mass.

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</table>

Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Flipped Video Introduction: Students watch videos on each application and then develop class notes, practice, and quiz in class	Text: Single Variable Calculus
	Calculus Problem Book 1120-1165	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	Geometry Sketch Pad Volume Demonstrations	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Play-Doh exploration of volume of slicing.	GeoGebra Software. From http://www.geogebra.org
	Barron's: Applications of Integration to Geometry (*Done later in the year for AP prep *)	Text: Barron's AP Calculus Prep Book
		Graphing Calculator (TI 83, 84, or 89 recommended)
	Suggested Activities	**Suggested Resources**
	TI Calculator Lab #7	Internet
	Create class displays with examples of each type of application.	Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
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Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:

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- Use multiple modes of teacher presentation
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- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #9: Series	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	10 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
A-APR.6 Rewrite rational expressions
F-IF.1-9: Analyze functions using different representations

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
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9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.
9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.
9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…

T1. Communicate about ideas of sequence, series, convergence and divergence in a standard and understandable manner.
T2. Students will relate the topics learned about sequence, series, convergence and divergence previously learned content, to other content areas, and to things that they do in their everyday lives.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Infinite sequences can converge to finite values. U2. Infinite series can converge to finite values.	Q1. When does a sequence converge versus diverge? Q2. When does a series converge versus diverge? Q3. What tests can be used to test for convergence? Q4. How a series can be defined as a sequence of partial sums?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. What is meant by an inconclusive test. K2. Different sequence and series names and characteristics.	S1. Use of graphic calculator to demonstrate convergence/divergence of sequences and series S2. Determine the convergence/divergence of sequence and series using a variety of tests.

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Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Calculus Problem Book 1404-1540	Text: Single Variable Calculus
	Flipped Video Introduction: Students watch videos and then develop class notes, practice, and quiz in class.	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	Develop website/wiki for convergence tests.	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Barron's: Sequences and Sequences A, B	GeoGebra Software. From http://www.geogebra.org
		Text: Barron's AP Calculus Prep Book
	Suggested Activities	**Suggested Resources**
	Calculus Lab #8	Internet
	TI Lab #9	Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
Tic-Tac-Toe Menus	Skill-Based Mini Lessons
Learning Buddies	Tiered Products/Activities
Varied Rubrics	Choice Menus
Mentorships	Advance Notice of Assignments
Small Group Instruction	Review with Study Skills and Strategies Training
Visual Cues Found on Worksheets	Teach Organizational Skills
Chunking and Grouping of Material	Test Modifications
Advanced Notice of Assignment	Time Extensions
Review with Study Skills and Strategies Training	
Teach Organizational Skills	
Test Modifications/Time Extensions	

STUDENTS BELOW TARGET:

- Pretest students to assess key pre-skills and background knowledge
- Using compacting strategy to account for prior student mastery of objectives
- Provide grouping by difficulty level, with varying levels of support (Tiering)
- Provide different demonstrations or models
- Offer choice of response (verbal, using numerical representations, creating a diagram)
- Use story mapping for understanding of word problems
- Provide practice in measuring with varied units
- Work on decimals, fractions, and percents in real-life situations using newspaper ads, catalogs, and checkbooks
- Use computer software to review and reinforce skills taught
- Assign homework targeted to student need at key points

- Use multiple modes of teacher presentation
- Use think-pair-share groups
- Use of manipulatives
- Provision of calculator
- Use flash cards, number line, graph paper
- Use games to provide reinforcement of math skills
- Use interest centers/groups to allow students to choose topic of interest
- Use of learning contracts that allow student to work at appropriate pace, learn planning skills and eliminate
- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #10: Approximating Functions	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	10 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
A-APR.6 Rewrite rational expressions
F-IF.1-9: Analyze functions using different representations

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
9.1.12.A.1: Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.A.2: Participate in online strategy and planning sessions for course-based, school-based, or outside projects.
9.1.12.B.1: Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.
9.1.12.C.5: Assume a leadership position by guiding the thinking of peers in a direction that leads to successful completion of a challenging task or project.
9.1.12.F.2: Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.

21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…
T1. Communicate the value of developing alternative representations of functions.
T2. Analyze real life situations in a mathematical way.
T3. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Complex functions can be approximated using a series of simpler algebraic terms.	Q1. How is the error of an approximation of a function impacted by the number of terms and radius of convergence?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. Different approximation techniques and their characteristics.	S1. Develop Taylor polynomial approximations. S2. Develop Maclaurin series approximations. S3. Use L'Hopital's Rule in determining convergence behavior. S4. Compute Lagrange error bounds for Taylor polynomials.

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Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Flipped Video Lessons Introductions: Student view videos and develop class notes, practice, and quiz in class.	Text: Single Variable Calculus
	Calculus Lab #9	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	GeoGebra: Taylor approximations Applet	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Calculus Problem Books problems 1299-1329, 1541-1561	GeoGebra Software. From http://www.geogebra.org
	Barron's: Series and Sequences C	Text: Barron's AP Calculus Prep Book
	Suggested Activities	**Suggested Resources**
	Read Online Text: Calculus II – Series and Sequence (approximate sections)	Internet
	Calculus Lab #9	Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
QAR	Choice Boards
Cooperative Learning	Independent Study
Choice Boards	Interest Based Mini Lessons
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STUDENTS BELOW TARGET:

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- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #11: Differential Equations	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	10 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems
A-APR.6 Rewrite rational expressions
F-IF.1-9: Analyze functions using different representations

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
8.1.12.F.2: Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
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21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…
T1. Communicate about implicitly solved differentials in a standard and understandable manner.
T2. Relate the topics learned about implicitly solved differentials to things they previously learned and to other content areas.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Implicitly derived derivatives often have an antiderivative that cannot be evaluated without using advanced differential techniques. U2. The meaning of differential equations and their solutions.	Q1. How do you solve for the constants of integration? Q2. When are analytical solutions to differentials appropriate? Q3. Why do numerical methods to approximate integrals?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. Real-world applications of differential equations. K2. Geometric interpretations using slope fields to find solutions.	S1. Apply Euler's Method. S2. Analytically separation variables and solve. S3. Solve exponential (y'=ky) & Logistic models S4. Develop models of population growth S5. Newton's Law of Heating & Cooling S6. Use the calculator activities for slope fields

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Learning Plan (Stage 3)

Checks for alignment and best practice	**Summary of Key Learning Events and Instruction** *The teaching and learning needed to achieve the unit goals.*	
	Required Activities	**Required Resources**
	Flipped Video Introduction: Students watch videos and then develop class notes, practice, and quiz in class.	Text: Single Variable Calculus
	Calculus Problem Book: 1166-1209	Online Calculus Text: By Dr. Paul Dawkins of Lamar University http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
	College Board Slope Fields Workshop Materials	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
	Barron's: Differential Equations (*Done later in the year for AP prep *)	GeoGebra Software. From http://www.geogebra.org
		Text: Barron's AP Calculus Prep Book
	Suggested Activities	**Suggested Resources**
	TI Calculator Lab #8	Internet
		Mathematics Library
		Mathematics Lab
		College Board Released Resources

Strategies for Differentiation	
Paired/Group Activity	Role Play
Guided Practice	SQ3R
Role Play	Cooperative Learning
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- unnecessary skill practice
- Provide use of choice boards which contain a variety of activities for skill acquisition
- Use ongoing assessment of readiness and interests
- Tier graphic organizers

Title of Unit	Unit #12: Parametric, Vector, and Polar	Grade Level	12
Curriculum Area	AP Calculus BC	Time Frame	10 Days
Developed By	B. Miller		

Desired Results (Stage 1)

Established Goals

F-IF.1-9: Analyze functions using different representations
N-CN.1-9 Use complex number in polynomial inequalities and equations
N-VM.1-12 Perform operations on matrices and use matrices in applications.
A-SSE.1-4 Interpret the structure of expressions, Write expressions in equivalent forms to solve problems

Primary Interdisciplinary Connections

8.1.12.A.3: Participate in online courses, learning communities, social networks, or virtual worlds and recognize them as resources for lifelong learning.
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21st Century Interdisciplinary Themes:

__X__ Global Awareness
__X__ Financial, economic, business, and entrepreneurial literacy
_____ Civic Literacy
_____ Health Literacy

Transfer

Students will be able to independently use their learning to…
T1. Communicate about parametric equations, vectors, and polar coordinates in a standard and understandable manner.
T2. Relate the topics learned about parametric equations, vectors, and polar coordinates to previously learned content and to other content areas.
T3. Analyze real life situations in a mathematical way.
T4. Become proficient in daily skills involving math.

Meaning	
Understandings	**Essential Questions**
Students will understand that…	Students will keep considering…
U1. Polar, vectors, and parametric representations of equations are subject to the integral and derivatives.	Q1. How can expressions be represented in polar coordinates? Q2. How can vector quantities be differentiated and integrated? Q3. How can the derivative an integral of parametric equations be evaluated?
Acquisition	
Knowledge Students will know…	**Skills** Students will be able to…
K1. Algebraic and geometric representations of polar, parametric, and vector-valued functions.	S1. Use the calculator to graph functions S2. Apply derivatives of parametric, polar and vector-valued functions to velocity and acceleration and modeling projectile motion S3. Apply integration of functions given in parametric, polar, vector-valued to distance traveled, arc length and areas of regions bounded by polar curves

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	Calculus Problem Book Practice AP Test Six	Text: The Calculus Problem Book 4th Edition by Chuck Garner, PhD.
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