VERNON TOWNSHIP
SCHOOL DISTRICT

Calculus Honors
Curriculum Map

Adapted from:
Understanding By Design

Reviewed by:
Vincent Gagliostro - Director of Curriculum & Instruction

Adopted:
April 2025

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Superintendent of Schools:
Russell Rogers

Vernon School District
PO Box 99
625 Route 517
Vernon, NJ 07462
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Course Description

Calculus Honors is a full year first-level college course designed for students who will pursue a study in mathematics, science, engineering, business, pharmacy or medicine. Calculus Honors covers limits, derivatives, integrals, approximation, applications and modeling. It is an advanced mathematics course that analyzes meaningful real life situations and uses appropriate technology to develop concepts and applications related to continuity and discontinuity of functions as well as differentiation and integration. Students enrolled in this course will not prepare for the AP Calculus exam, which will allow them to cover the same material as the AB Calculus course, but at a slower pace.
Based upon the following list of proficiencies, each student must demonstrate a minimum competency level of 65%. Competencies will be measured by way of an evaluation program consisting of teacher observations of student performance, tests, quizzes, classwork, homework, projects, and class participation, as well as class attendance in accordance with the high school's attendance policy.

Successful completion of this course earns 5 credits toward graduation.

Various Levels of Text: Supplemental text and audio visual materials are provided for above grade level and below grade level for students who need them.

AI tools and Text to Speech tools may be used to adapt the lexile level of grade level materials.

New Jersey Learning Standards covered throughout the course

In addition to the New Jersey Student Learning Standards(HS) , The College Board (Enduring Understanding(EU) and Learning Objectives(LO)) has additional practices for students enrolled in the **Calculus Honors** course. Students will demonstrate the ability to:

MPAC 1: Reasoning with definitions and theorems

Reasoning with definitions and theorems is one of the dominant themes in the development of each new idea and of the exercises. Definitions and theorems are highlighted in each section and summarized at the end of each chapter for reference and review.

MPAC 2: Connecting concepts

Connecting concepts runs throughout this book, introducing new concepts by connecting them to what has come before and in the reliance of many exercises that draw on applications or build on student knowledge. Quick Review exercises at the start of each Exercise set review concepts from previous sections (or previous courses) that will be needed for the solutions.

MPAC 3: Implementing algebraic/computational processes

Implementing algebraic/computational processes is well represented in the foundational exercises with which each exercise set begins and in the thoughtful use of technology.

MPAC 4: Connecting multiple representations

Connecting multiple representations has always been present in the emphasis on the connections among graphical, numerical, and algebraic representations of the key concepts of calculus. The title of this book speaks for itself in that regard.

MPAC 5: Building notational fluency

Building notational fluency is represented in the intentional use of a variety of notational forms and in their explicit connection to graphical, numerical, and algebraic representations. Many margin notes explicitly address notational concerns.

MPAC 6: Communicating

Communicating is a critical component of the Explorations that appear in each section. Communication is also essential to the Writing to Learn exercises as well as the Group Activities. Many of the exercises and examples in the book have “justify your answer” components in the spirit of the AP exams.

Grading Criteria
• Major - 80% • Minor - 20%

Course Resources

Text:

- Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy

Technologies

- Personal computer with Internet access, a web browser and word processing, presentation software for both teacher and student use
- Software and web-based presentation resources
- Graphing Calculator

Supplemental Materials

- Learning Plans/Schoology
- Worksheets
- Extra Practice
- Homework
- Projects

Scope and Sequence- Topical Outline

Unit	Title	Time
1	Prerequisites for Calculus (climate change)	4 Weeks
2	Limits and Continuity (DEI)	4 Weeks
3	Derivatives	5 Weeks
4	More Derivatives (DEI)	4 Weeks
	Midterm Exam	1 Week
5	Extreme Values of Functions (climate change)	4 Weeks
6	The Definite Integral	4 Weeks
7	Differential Equations and Mathematical Modeling (climate change) (DEI)	3 Weeks

8	Applications of Definite Integrals	4 Weeks
9	L'Hopital's Rule and Improper Integrals (DEI)	2 Weeks
	Final Exam	1 Week

The timeline is only an approximation. The inclusion of a classroom project in any one of the above units would extend the time allotment.

Subject Area: Math		**Level: Calculus Honors**	
Unit	**1 Prerequisites for Calculus**	**2 Limits & Continuity**	**3 Derivatives**
Timeframe	4 Weeks	4 Weeks	5 Weeks
Established Goals	**1 Implementing Mathematical Processes:** ● 1.A Identify the question to be answered or problem to be solved (not assessed). ● 1.B Identify key and relevant information to answer a question or solve a problem (not assessed).	**1 Implementing Mathematical Processes:** ● 1.A Identify the question to be answered or problem to be solved (not assessed). ● 1.B Identify key and relevant information to answer a question or solve a problem (not assessed).	**1 Implementing Mathematical Processes:** ● 1.A Identify the question to be answered or problem to be solved (not assessed). ● 1.B Identify key and relevant information to answer a question or solve a problem (not assessed).

	• 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function). • 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in problems involving different contextual situations.	• 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function). • 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in problems involving different contextual situations.	• 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function). • 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in problems involving different contextual situations.

	• 2.B Identify mathematical information from graphical, numerical, analytical, and/or verbal representations. • 2.C Identify a re-expression of mathematical information presented in a given representation. 2.D Identify how mathematical characteristics or properties of functions are related in different representations. • 2.E Describe the relationships among different representations of functions and their derivatives. **3 Justification** • 3.A Apply technology to develop claims and conjectures (not assessed). • 3.B Identify an appropriate mathematical definition, theorem, or test to apply. • 3.C Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied.	• 2.B Identify mathematical information from graphical, numerical, analytical, and/or verbal representations. • 2.C Identify a re-expression of mathematical information presented in a given representation. 2.D Identify how mathematical characteristics or properties of functions are related in different representations. • 2.E Describe the relationships among different representations of functions and their derivatives. **3 Justification** • 3.A Apply technology to develop claims and conjectures (not assessed). • 3.B Identify an appropriate mathematical definition, theorem, or test to apply. • 3.C Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied.	• 2.B Identify mathematical information from graphical, numerical, analytical, and/or verbal representations. • 2.C Identify a re-expression of mathematical information presented in a given representation. 2.D Identify how mathematical characteristics or properties of functions are related in different representations. • 2.E Describe the relationships among different representations of functions and their derivatives. **3 Justification** • 3.A Apply technology to develop claims and conjectures (not assessed). • 3.B Identify an appropriate mathematical definition, theorem, or test to apply. • 3.C Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied.

	• 3.D Apply an appropriate mathematical definition, theorem, or test. • 3.E Provide reasons or rationales for solutions and conclusions. 3.F Explain the meaning of mathematical solutions in context. • 3.G Confirm that solutions are accurate and appropriate **4 Communication and Notation** • 4.A Use precise mathematical language. • 4.B Use appropriate units of measure. • 4.C Use appropriate mathematical symbols and notation (e.g., Represent a derivative using f'(x), y', and dy dx). • 4.D Use appropriate graphing techniques. • 4.E Apply appropriate rounding procedures.	• 3.D Apply an appropriate mathematical definition, theorem, or test. • 3.E Provide reasons or rationales for solutions and conclusions. 3.F Explain the meaning of mathematical solutions in context. • 3.G Confirm that solutions are accurate and appropriate **4 Communication and Notation** • 4.A Use precise mathematical language. • 4.B Use appropriate units of measure. • 4.C Use appropriate mathematical symbols and notation (e.g., Represent a derivative using f'(x), y', and dy dx). • 4.D Use appropriate graphing techniques. • 4.E Apply appropriate rounding procedures.	• 3.D Apply an appropriate mathematical definition, theorem, or test. • 3.E Provide reasons or rationales for solutions and conclusions. 3.F Explain the meaning of mathematical solutions in context. • 3.G Confirm that solutions are accurate and appropriate **4 Communication and Notation** • 4.A Use precise mathematical language. • 4.B Use appropriate units of measure. • 4.C Use appropriate mathematical symbols and notation (e.g., Represent a derivative using f'(x), y', and dy dx). • 4.D Use appropriate graphing techniques. • 4.E Apply appropriate rounding procedures.
Learning Objectives	• HSA-APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.	• **EU 1.1: The concept of a limit can be used to understand the behavior of functions.** • **LO 1.1A(a): Express limits symbolically using correct notation.**	• **EU 2.1: The derivative of a function is defined as the limit of a difference quotient and can be determined using a variety of strategies.**

	• HSA-REI.B.4 Solve quadratic equations in one variable. • HSA-APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. • HSA-REI-D.11 Explain why the x-coordinates of the points where the graphs of the equations y= f(x) and y= g(x) intersect are the solutions of the equation f(x) = g(x) • HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. • HSF-IF.B.6Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. • HSF-IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. • HSF-TF.A.1 Understand the radian measure of an angle as the length of the arc on the unit	• **LO 1.1A(b): Interpret limits expressed symbolically.** • **LO 1.1B: Estimate limits of functions.** • **LO 1.1C: Determine limits of functions.** • **LO 1.1D: Deduce and interpret behavior of functions using limits.** • **EU 1.2: Continuity is a key property of functions that is defined using limits.** • **LO 1.2A: Analyze functions for intervals of continuity or points of discontinuity.** • **LO 1.2B: Determine the applicability of important calculus theorems using continuity.**	• **LO 2.1A: Identify the derivative of a function as the limit of a difference quotient.** • **LO 2.1B: Estimate the derivative.** • **LO 2.1C: Calculate derivatives.** • **LO 2.1D: Determine higher order derivatives.** • **EU 2.2: A function's derivative, which is itself a function, can be used to understand the behavior of the function.** • **LO 2.2A: Use derivatives to analyze properties of a function.** • **LO 2.2B: Recognize the connection between differentiability and continuity.** • **EU 2.3: The derivative has multiple interpretations and applications including those that involve instantaneous rates of change.** • **LO 2.3A: Interpret the meaning of a derivative within a problem.** • **LO 2.3B: Solve problems involving the slope of a tangent line.** • **LO 2.3C: Solve problems involving related rates,**

	circle subtended by the angle. • HSF-TF.A.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number. • HSF-TF.A.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. • HSF-TF.B.6 Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. • HSF-TF.B.7 Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. • HSF-TF.C.8 Prove the		**optimization, rectilinear motion, (BC) and planar motion.** • **LO 2.3D: Solve problems involving rates of change in applied contexts.** • **LO 2.3E: Verify solutions to differential equations.** • **LO 2.3F: Estimate solutions to differential equations.** • **EU 2.4: The Mean Value Theorem connects the behavior of a differentiable function over an interval to the behavior of the derivative of that function at a particular point in the interval.** • **LO 2.4A: Apply the Mean Value Theorem to describe the behavior of a function over an interval.**

	Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.		
Essential Questions	• How are the sine graph and cosine graph related? • Why is the parametric equation different from the y=mx+b? • What does the rate of change increasing tell you about the graph of the function?	• How can limits be used to describe a function's behavior near a point of discontinuity? • How do vertical and horizontal asymptotes differ? • What does it mean for a function to be continuous?	• What is the difference between speed and velocity? • What does a derivative of zero tell you about the function at that point?
Content Knowledge and Skills	*Students will learn and be able to:* • use increments to calculate slopes. • write an equation and sketch a graph a line given specific information • identify the relationships between parallel lines, perpendicular lines, and slopes • to use linear regression equations to solve problems • identify the domain and range of a function using its graph or equation • recognize even functions and odd functions using equations and equations • interpret and find formulas for piecewise defined functions • write and evaluate compositions of two functions	*Students will learn and be able to:* • calculate average and instantaneous speeds • define and calculate limits for function values and apply the properties of limits • use the Sandwich Theorem to find certain limits indirectly • find and verify end behavior models for various functions • calculate limits as x-> +/- infinity and to identify vertical and horizontal asymptotes • identify the intervals upon which a given function is continuous and understand the meaning of continuous function • able to remove removable discontinuities by extending or modifying a function	*Students will learn and be able to:* • calculate slopes and derivatives, using the definition of the derivative • graph f from the graph of f`, graph f` from the graph of f, and graph the derivative of a function given numerically with data • find where a function is not differentiable and distinguish between corners, cusps, discontinuities, and vertical tangents • approximate derivatives numerically and graphically • use the rules of differentiation to calculate derivatives, including second and higher order derivatives

	• determine the domain, range, and graph of an exponential function • solve problems involving exponential growth and decay • use exponential regression equations to solve problems • graph curves that are described, using parametric equations • find parameterizations of circles, ellipses, line segments, and other curves • identify a one-to-one function • determine the algebraic representation and the graphical representation of a function and its inverse • convert between radians and degrees, and find arc length • identify the periodicity and even-odd properties of the trigonometric functions • find values of trigonometric functions • generate the graphs of the trigonometric functions and explore various transformations upon these graphs • use the inverse trigonometric functions to solve problems	• able to apply the Intermediate Value Theorem and the properties of algebraic combinations and composites of continuous functions • apply directly the definition of the slope of a curve in order to calculate slopes • find the equations of the tangent line and normal line to a curve at a given point • find the average rate of change of a function	• use the derivative to calculate the instantaneous rate of change • use derivatives to analyze straight line motion and solve other problems involving rates of change • use the rules for differentiating the six basic trigonometric functions

Performance Tasks	• Quizzes • Modified Chapter Assessments from Calculus AB • Released AP Questions	• Quizzes • Modified Chapter Assessments from Calculus AB • Released AP Questions	• Quizzes • Modified Chapter Assessments from Calculus AB • Released AP Questions

Other Assessment Evidence	• Benchmark:
	  ○ Unit 1 Test (reflecting college placement exam)
	• Formative:
	  ○ Warm up/Problem of the Day
	  ○ Lesson
	  ○ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations
	  ○ Independent Practice/Classwork/Homework
	• Summative:
	  ○ Homework 1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 1-7
	  ○ Quiz 1-1 - 1-3, 1-4 - 1-6
	  ○ Test 1
		• Benchmark:
		  ○ Unit 1 Test (reflecting college placement exam)
		• Formative:
		  ○ Warm up/Problem of the Day
		  ○ Lesson
		  ○ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations
		  ○ Independent Practice/Classwork/Homework
		• Summative:
		  ○ Homework 2-1, 2-2, 2-3, 2-4, 2-5, 2-6
		  ○ Quiz 2-1 - 2-2, 2-3 - 2-4
		  ○ Test 2
			• Benchmark:
			  ○ Unit 1 Test (reflecting college placement exam)
			• Formative:
			  ○ Warm up/Problem of the Day
			  ○ Lesson
			  ○ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations
			  ○ Independent Practice/Classwork/Homework
			• Summative:
			  ○ Homework 3-1, 3-2, 3-3, 3-4, 3-5
			  ○ Quiz 3-1 - 3-3
			  ○ Test 3

Resources/Materials	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links

	• Online Videos • Quizizz • Google Slide notes	• Online Videos • Quizizz • Google Slide notes	• Online Videos • Quizizz • Google Slide notes

Interdisciplinary Connections	• RL.CR.11–12.1. Accurately cite strong and thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.
	  ○ Have students read real-world articles involving statistical data (financial reports, climate change data), interpret graphs and equations, and write an analysis.
	• Science: HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system is conserved.
	  ○ Apply systems of equations to collision problems in physics where momentum conservation equations must be solved
		• Physics: HS-PS2-1 – Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
		  ○ Students investigate how acceleration changes as time approaches a certain point (e.g., during a falling object's motion) and use the concept of a limit to describe instantaneous rates of change.
		•
			• Biology: HS-LS2-1 – Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems.
			  ○ Model population growth using functions. Use derivatives to analyze the rate of change in population over time and identify points of maximum growth (critical points).
			• Social Studies: 6.1.12.EconNE.5.a – Analyze economic trends using economic indicators (e.g., GDP, CPI, unemployment).
			  ○ Use derivatives to analyze changes in economic indicators—students calculate the rate of change in inflation or unemployment over time and identify turning points.

	simultaneously. ● Social Studies: 6.1.12.EconNE.16.a: Analyze the impact of technological innovation on labor conditions and economic stability. ○ Use exponential and linear models to compare trends in job market growth or automation adoption and interpret impacts through math-based graphs and functions.		
Learning Activities	● Homework Check ● Learn/Lesson ● Classwork/Homework	● Homework Check ● Learn/Lesson ● Classwork/Homework	● Homework Check ● Learn/Lesson ● Classwork/Homework

Subject Area: Math		**Level: Calculus Honors**	
Unit	**4 More Derivatives**	**5 Extreme Values of Functions**	**6 The Definite Integrals**
Timeframe	4 Weeks	4 Weeks	4 Weeks
Established Goals	**1 Implementing Mathematical Processes:** ● 1.A Identify the question to be answered or problem to be solved (not assessed). ● 1.B Identify key and relevant information to answer a	**1 Implementing Mathematical Processes:** ● 1.A Identify the question to be answered or problem to be solved (not assessed). ● 1.B Identify key and relevant information to answer a question	**1 Implementing Mathematical Processes:** ● 1.A Identify the question to be answered or problem to be solved (not assessed). ● 1.B Identify key and relevant information to answer a

	question or solve a problem (not assessed). • 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function). • 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in	or solve a problem (not assessed). • 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function). • 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in	question or solve a problem (not assessed). • 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function). • 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in

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Learning Objectives	• **EU 2.1: The derivative of a function is defined as the limit of a difference quotient and**	• **EU 2.1: The derivative of a function is defined as the limit of a difference quotient and**	• EU 3.2: The definite integral of a function over an interval is the limit of a Riemann sum over that interval and can be

	can be determined using a variety of strategies. • **LO 2.1A: Identify the derivative of a function as the limit of a difference quotient.** • **LO 2.1B: Estimate the derivative.** • **LO 2.1C: Calculate derivatives.** • **LO 2.1D: Determine higher order derivatives.** • **EU 2.2: A function's derivative, which is itself a function, can be used to understand the behavior of the function.** • **LO 2.2A: Use derivatives to analyze properties of a function.** • **LO 2.2B: Recognize the connection between differentiability and continuity.** • **EU 2.3: The derivative has multiple interpretations and applications including those that involve instantaneous rates of change.** • **LO 2.3A: Interpret the meaning of a derivative within a problem.** • **LO 2.3B: Solve problems involving the slope of a tangent line.**	**can be determined using a variety of strategies.** • **LO 2.1A: Identify the derivative of a function as the limit of a difference quotient.** • **LO 2.1B: Estimate the derivative.** • **LO 2.1C: Calculate derivatives.** • **LO 2.1D: Determine higher order derivatives.** • **EU 2.2: A function's derivative, which is itself a function, can be used to understand the behavior of the function.** • **LO 2.2A: Use derivatives to analyze properties of a function.** • **LO 2.2B: Recognize the connection between differentiability and continuity.** • **EU 2.3: The derivative has multiple interpretations and applications including those that involve instantaneous rates of change.** • **LO 2.3A: Interpret the meaning of a derivative within a problem.** • **LO 2.3B: Solve problems involving the slope of a tangent line.**	calculated using a variety of strategies. • LO 3.2A(a): Interpret the definite integral as the limit of a Riemann sum. • LO 3.2A(b): Express the limit of a Riemann sum in integral notation. • LO 3.2B: Approximate a definite integral. • LO 3.2C: Calculate a definite integral using areas and properties of definite integrals. • LO 3.2D: (BC) Evaluate an improper integral or show that an improper integral diverges • EU 3.3: The Fundamental Theorem of Calculus, which has two distinct formulations, connects differentiation and integration. • LO 3.3A: Analyze functions defined by an integral. • LO 3.3B(a): Calculate antiderivatives. • LO 3.3B(b): Evaluate definite integrals. • EU 3.4: The definite integral of a function over an interval is a mathematical tool with many interpretations and applications involving accumulation.

	• **LO 2.3C: Solve problems involving related rates, optimization, rectilinear motion, (BC) and planar motion.** • **LO 2.3D: Solve problems involving rates of change in applied contexts.** • **LO 2.3E: Verify solutions to differential equations.** • **LO 2.3F: Estimate solutions to differential equations.** • **EU 2.4: The Mean Value Theorem connects the behavior of a differentiable function over an interval to the behavior of the derivative of that function at a particular point in the interval.** • **LO 2.4A: Apply the Mean Value Theorem to describe the behavior of a function over an interval.**	• **LO 2.3C: Solve problems involving related rates, optimization, rectilinear motion, (BC) and planar motion.** • **LO 2.3D: Solve problems involving rates of change in applied contexts.** • **LO 2.3E: Verify solutions to differential equations.** • **LO 2.3F: Estimate solutions to differential equations.** • **EU 2.4: The Mean Value Theorem connects the behavior of a differentiable function over an interval to the behavior of the derivative of that function at a particular point in the interval.** • **LO 2.4A: Apply the Mean Value Theorem to describe the behavior of a function over an interval.**	• LO 3.4A: Interpret the meaning of a definite integral within a problem. • LO 3.4B: Apply definite integrals to problems involving the average value of a function. • LO 3.4C: Apply definite integrals to problems involving motion. • LO 3.4D: Apply definite integrals to problems involving area, volume, (BC) and length of a curve. • LO 3.4E: Use the definite integral to solve problems in various contexts. • EU 3.5: Antidifferentiation is an underlying concept involved in solving separable differential equations. Solving separable differential equations involves determining a function or relation given its rate of change. • LO 3.5A: Analyze differential equations to obtain general solutions. • LO 3.5B: Interpret, create, and solve differential equations from problems in context.
Essential Questions	• How do we find the rate of change at a point if we are unable to solve for y • Why does y=e^x the same graph as y'?	• What is a point of inflection? • How can the equation of a tangent at a point be used to estimate the value of the function at a nearby point?	• What is the Fundamental Theorem of Calculus? • How are Integrals related to derivatives? • What is the area under the

	• What is the graph of the derivative y= sin(x)?	• How can derivatives be used to solve real world problems?	velocity curve and how is it found?

Content Knowledge and Skills	*Students will learn and be able to:* ● differentiate composite functions using the Chain Rule ● find derivatives, using implicit differentiation ● find derivatives, using the Power Rule for Rational Powers of x ● calculate derivatives of functions involving the inverse trigonometric functions ● calculate derivatives of exponential and logarithmic functions	*Students will learn and be able to:* ● determine the local or global extreme values of a function ● apply the Mean Value Theorem and find the intervals on which a function is increasing or decreasing ● use the First and Second Derivative Tests to determine the local extreme values of a function ● determine the concavity of a function and locate the points of inflection by analyzing the second derivative ● graph f using information about f' ● solve application problems involving finding minimum or maximum values of functions ● find linearizations of a function and Newton's method to approximate the zeros of a function ● estimate the change in a function using differentials ● solve related rate problems	*Students will learn and be able to:* ● approximate the area under the graph of a nonnegative continuous function by using rectangle approximation methods ● interpret the area under a graph as a net accumulation of a rate of change ● express the area under a curve as a definite integral and as a limit of Riemann sums ● compute the area under under a curve using a numerical integration procedure ● apply rules for definite integrals and find the average value of a function over a closed interval ● apply the Fundamental Theorem of Calculus ● understand the relationship between the derivative and definite integral as expressed in both parts of the Fundamental Theorem of Calculus ● approximate the definite integral by using the Trapezoidal Rule and by using Simpson's Rule, and estimate the error in using the Trapezoidal and Simpson's Rules

Performance Tasks	• Quizzes • Modified Chapter Assessments from Calculus AB • Released AP Questions • Midterm Exam	• Quizzes • Modified Chapter Assessments from Calculus AB • Released AP Questions	• Quizzes • Modified Chapter Assessments from Calculus AB • Released AP Questions

Other Assessment Evidence	• Benchmark:
	  ○ Midterm Exam
	• Formative:
	  ○ Warm up/Problem of the Day
	  ○ Lesson
	  ○ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations
	  ○ Independent Practice/Classwork/Homework
	• Summative:
	  ○ Homework 4-1, 4-2, 4-3, 4-4, 4-5, 4-6
	  ○ Quiz 4-1 - 4-3
	  ○ Test 4
		• Benchmark:
		  ○ Unit 2 Test (reflecting college placement exam)
		• Formative:
		  ○ Warm up/Problem of the Day
		  ○ Lesson
		  ○ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations
		  ○ Independent Practice/Classwork/Homework
		• Summative:
		  ○ Homework 5-1, 5-2, 5-3, 5-4, 5-5, 5-6, 5-7
		  ○ Quiz 5-1 - 5-2, 5-3 - 5-5
		  ○ Test 5
			• Benchmark:
			  ○ Unit 2 Test (reflecting college placement exam)
			• Formative:
			  ○ Warm up/Problem of the Day
			  ○ Lesson
			  ○ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations
			  ○ Independent Practice/Classwork/Homework
			• Summative:
			  ○ Homework 6-1, 6-2, 6-3, 6-4, 6-5
			  ○ Quiz 6-1 - 6-2, 6-3
			  ○ Test 6

Resources/Materials	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links

	• Online Videos • Quizizz • Google Slide notes	• Online Videos • Quizizz • Google Slide notes	• Online Videos • Quizizz • Google Slide notes
Interdisciplinary Connections	**Physics: Motion and Velocity (Derivatives in Motion)** **Activity**: Students can explore how the velocity of a moving object is the derivative of its position function with respect to time. By analyzing real-life motion (like a car moving on a road or a ball thrown in the air), students can create position-time graphs and calculate velocity at specific points. **NJ Science Standards**: • **PS2.A: Forces and Motion** *Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)* **Link**: This connects math with physics through motion analysis, using the derivative to understand velocity and acceleration.	**Economics: Maximizing Profit (Extreme Values in Business)** **Activity**: Students can use extreme value theory to find the optimal price for a product by maximizing revenue or minimizing cost. They can model a business scenario where they maximize profit by determining the optimal number of products to produce, using the first and second derivative tests to find critical points and determine whether they represent maxima or minima. **NJ Financial Literacy Standards**: • **9.1.12.FP.7:** *Determine how multiple sources of objective, accurate and current financial information affect the prioritization of financial decisions (e.g., print information, prospectus, certified financial planners, internet, sales representatives, etc.).* **Link**: This connects mathematics (optimization) with economics, allowing	**Health: Calculating Caloric Burn (Definite Integrals in Health)** **Activity**: Students can model the rate at which calories are burned during exercise over a given time. By integrating the function of the rate of caloric burn with respect to time, they can calculate the total number of calories burned during a specific activity (like running or swimming). **NJ Health & Physical Ed Standards**: • **New Jersey State Standard: 2.2.12.PF.5:** *Analyze fitness knowledge in strength, conditioning, agility, and the physiological responses of the energy systems effects on the mind and body before, during, and after physical fitness activities.*

		students to use derivatives to find maximum profit and apply extreme values in business decision-making.	
Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework	• Homework Check • Learn/Lesson • Classwork/Homework	• Homework Check • Learn/Lesson • Classwork/Homework

Subject Area: Math		**Level: Calculus Honors**	
Unit	**7 Differential Equations & Mathematical Modeling**	**8 Applications of Definite Integrals**	**9 L'Hopital's Rule and Improper Integrals**
Timeframe	3 Weeks	4 Weeks	2 Weeks
Established Goals	**1 Implementing Mathematical Processes:** • 1.A Identify the question to be answered or problem to be solved (not assessed). • 1.B Identify key and relevant information to answer a question or solve a problem (not assessed). • 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function).	**1 Implementing Mathematical Processes:** • 1.A Identify the question to be answered or problem to be solved (not assessed). • 1.B Identify key and relevant information to answer a question or solve a problem (not assessed). • 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function).	**1 Implementing Mathematical Processes:** • 1.A Identify the question to be answered or problem to be solved (not assessed). • 1.B Identify key and relevant information to answer a question or solve a problem (not assessed). • 1.C Identify an appropriate mathematical rule or procedure based on the classification of a given expression (e.g., Use the chain rule to find the derivative of a composite function).

	• 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in problems involving different contextual situations. • 2.B Identify mathematical information from graphical, numerical, analytical, and/or verbal representations. • 2.C Identify a re-expression of mathematical information	• 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in problems involving different contextual situations. • 2.B Identify mathematical information from graphical, numerical, analytical, and/or verbal representations. • 2.C Identify a re-expression of mathematical information	• 1.D Identify an appropriate mathematical rule or procedure based on the relationship between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, anti-differentiation) to solve problems. • 1.E Apply appropriate mathematical rules or procedures, with and without technology. • 1.F Explain how an approximated value relates to the actual value. **2 Connecting Representations:** • 2.A Identify common underlying structures in problems involving different contextual situations. • 2.B Identify mathematical information from graphical, numerical, analytical, and/or verbal representations. • 2.C Identify a re-expression of mathematical information

	presented in a given representation. 2.D Identify how mathematical characteristics or properties of functions are related in different representations. • 2.E Describe the relationships among different representations of functions and their derivatives. **3 Justification** • 3.A Apply technology to develop claims and conjectures (not assessed). • 3.B Identify an appropriate mathematical definition, theorem, or test to apply. • 3.C Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied. • 3.D Apply an appropriate mathematical definition, theorem, or test. • 3.E Provide reasons or rationales for solutions and conclusions. 3.F Explain the	presented in a given representation. 2.D Identify how mathematical characteristics or properties of functions are related in different representations. • 2.E Describe the relationships among different representations of functions and their derivatives. **3 Justification** • 3.A Apply technology to develop claims and conjectures (not assessed). • 3.B Identify an appropriate mathematical definition, theorem, or test to apply. • 3.C Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied. • 3.D Apply an appropriate mathematical definition, theorem, or test. • 3.E Provide reasons or rationales for solutions and conclusions. 3.F Explain the	presented in a given representation. 2.D Identify how mathematical characteristics or properties of functions are related in different representations. • 2.E Describe the relationships among different representations of functions and their derivatives. **3 Justification** • 3.A Apply technology to develop claims and conjectures (not assessed). • 3.B Identify an appropriate mathematical definition, theorem, or test to apply. • 3.C Confirm whether hypotheses or conditions of a selected definition, theorem, or test have been satisfied. • 3.D Apply an appropriate mathematical definition, theorem, or test. • 3.E Provide reasons or rationales for solutions and conclusions. 3.F Explain the

	meaning of mathematical solutions in context. • 3.G Confirm that solutions are accurate and appropriate **4 Communication and Notation** • 4.A Use precise mathematical language. • 4.B Use appropriate units of measure. • 4.C Use appropriate mathematical symbols and notation (e.g., Represent a derivative using f'(x), y', and dy dx). • 4.D Use appropriate graphing techniques. • 4.E Apply appropriate rounding procedures.	meaning of mathematical solutions in context. • 3.G Confirm that solutions are accurate and appropriate **4 Communication and Notation** • 4.A Use precise mathematical language. • 4.B Use appropriate units of measure. • 4.C Use appropriate mathematical symbols and notation (e.g., Represent a derivative using f'(x), y', and dy dx). • 4.D Use appropriate graphing techniques. • 4.E Apply appropriate rounding procedures.	meaning of mathematical solutions in context. • 3.G Confirm that solutions are accurate and appropriate **4 Communication and Notation** • 4.A Use precise mathematical language. • 4.B Use appropriate units of measure. • 4.C Use appropriate mathematical symbols and notation (e.g., Represent a derivative using f'(x), y', and dy dx). • 4.D Use appropriate graphing techniques. • 4.E Apply appropriate rounding procedures.
Learning Objectives	• EU 3.2: The definite integral of a function over an interval is the limit of a Riemann sum over that interval and can be calculated using a variety of strategies. • LO 3.2A(a): Interpret the definite integral as the limit of a Riemann sum. • LO 3.2A(b): Express the limit of a Riemann sum in integral notation. • LO 3.2B: Approximate a definite integral.	• EU 3.2: The definite integral of a function over an interval is the limit of a Riemann sum over that interval and can be calculated using a variety of strategies. • LO 3.2A(a): Interpret the definite integral as the limit of a Riemann sum. • LO 3.2A(b): Express the limit of a Riemann sum in integral notation. • LO 3.2B: Approximate a definite integral.	• EU 3.2: The definite integral of a function over an interval is the limit of a Riemann sum over that interval and can be calculated using a variety of strategies. • LO 3.2A(a): Interpret the definite integral as the limit of a Riemann sum. • LO 3.2A(b): Express the limit of a Riemann sum in integral notation. • LO 3.2B: Approximate a definite integral.

	• LO 3.2C: Calculate a definite integral using areas and properties of definite integrals. • LO 3.2D: (BC) Evaluate an improper integral or show that an improper integral diverges • EU 3.3: The Fundamental Theorem of Calculus, which has two distinct formulations, connects differentiation and integration. • LO 3.3A: Analyze functions defined by an integral. • LO 3.3B(a): Calculate antiderivatives. • LO 3.3B(b): Evaluate definite integrals. • EU 3.4: The definite integral of a function over an interval is a mathematical tool with many interpretations and applications involving accumulation. • LO 3.4A: Interpret the meaning of a definite integral within a problem. • LO 3.4B: Apply definite integrals to problems involving the average value of a function. • LO 3.4C: Apply definite integrals to problems involving motion. • LO 3.4D: Apply definite integrals to problems involving	• LO 3.2C: Calculate a definite integral using areas and properties of definite integrals. • LO 3.2D: (BC) Evaluate an improper integral or show that an improper integral diverges • EU 3.3: The Fundamental Theorem of Calculus, which has two distinct formulations, connects differentiation and integration. • LO 3.3A: Analyze functions defined by an integral. • LO 3.3B(a): Calculate antiderivatives. • LO 3.3B(b): Evaluate definite integrals. • EU 3.4: The definite integral of a function over an interval is a mathematical tool with many interpretations and applications involving accumulation. • LO 3.4A: Interpret the meaning of a definite integral within a problem. • LO 3.4B: Apply definite integrals to problems involving the average value of a function. • LO 3.4C: Apply definite integrals to problems involving motion. • LO 3.4D: Apply definite integrals to problems involving	• LO 3.2C: Calculate a definite integral using areas and properties of definite integrals. • LO 3.2D: (BC) Evaluate an improper integral or show that an improper integral diverges • EU 3.3: The Fundamental Theorem of Calculus, which has two distinct formulations, connects differentiation and integration. • LO 3.3A: Analyze functions defined by an integral. • LO 3.3B(a): Calculate antiderivatives. • LO 3.3B(b): Evaluate definite integrals. • EU 3.4: The definite integral of a function over an interval is a mathematical tool with many interpretations and applications involving accumulation. • LO 3.4A: Interpret the meaning of a definite integral within a problem. • LO 3.4B: Apply definite integrals to problems involving the average value of a function. • LO 3.4C: Apply definite integrals to problems involving motion. • LO 3.4D: Apply definite integrals to problems involving

	area, volume, (BC) and length of a curve. • LO 3.4E: Use the definite integral to solve problems in various contexts. • EU 3.5: Antidifferentiation is an underlying concept involved in solving separable differential equations. Solving separable differential equations involves determining a function or relation given its rate of change. • LO 3.5A: Analyze differential equations to obtain general solutions. • LO 3.5B: Interpret, create, and solve differential equations from problems in context.	area, volume, (BC) and length of a curve. • LO 3.4E: Use the definite integral to solve problems in various contexts. • EU 3.5: Antidifferentiation is an underlying concept involved in solving separable differential equations. Solving separable differential equations involves determining a function or relation given its rate of change. • LO 3.5A: Analyze differential equations to obtain general solutions. • LO 3.5B: Interpret, create, and solve differential equations from problems in context.	area, volume, (BC) and length of a curve. • LO 3.4E: Use the definite integral to solve problems in various contexts. • EU 3.5: Antidifferentiation is an underlying concept involved in solving separable differential equations. Solving separable differential equations involves determining a function or relation given its rate of change. • LO 3.5A: Analyze differential equations to obtain general solutions. • LO 3.5B: Interpret, create, and solve differential equations from problems in context.
Essential Questions	• How can creating a slope field help to identify the function? • What different types of growth are there? • How can a derivative be altered to help to integrate it?	• How can integration be used to find the volume of an object? • How can net change of a function be applied to real world situations?	• How does L'Hopital's Rule help us find a limit? • How can knowing the limit of other convergent theorems be applied to find the limit of a new function?
Content Knowledge and Skills	*Students will be able to:* • Construct antiderivatives using the Fundamental Theorem of Calculus. • Solve initial value problems in the form dy/dx = f(x), y = f(x). • Construct slope fields using technology and interpret slope fields as visualizations of	*Students will be able to:* • Solve problems in which a rate is integrated to find the net change over time in a variety of applications. • Use integration to calculate areas of regions in a plane. • Use integration (by slices or shells) to calculate volumes of	*Students will be able to:* • Define sequences explicit or recursive. • Define explicit and recursive rules for arithmetic and geometric sequences. • Graph sequences using parametric or graphing mode. • Use properties of limits to find

	different equations. ● Gse Euler's Method for graphing a solution to an initial value problem. ● Compute indefinite and definite integrals by the method of substitution. ● Use integration by parts to evaluate indefinite and definite integrals. ● Use tabular integration or the method of solving for the unknown integral in order to evaluate integrals that require repeated use of integration by parts. ● Use integration by parts to integrate inverse trigonometric and logarithmic functions. ● Solve problems involving exponential growth and decay in a variety of applications. ● Solve problems involving exponential or logistic population growth.	solids. ● Use integration to calculate surface areas of solids of a revolution. ● Use integration to calculate lengths of curves in a plane. ● Adapt their knowledge or integral calculus to model problems involving rates or change in a variety of applications, possibly in unfamiliar contexts.	the limit of a sequence. ● Determine whether a sequence converges or diverges and find its limit using the Sandwich Theorem for Sequences or the Absolute Value Theorem. ● Find limits or indeterminate forms using L'Hopital's Rule. ● Use L'Hopital's Rule to compare the rates of growth of functions. ● Use limits to evaluate improper integrals. ● Use the direct comparison test and the limit comparison test to determine the convergence or divergence of improper integrals.
Performance Tasks	● Quizzes ● Modified Chapter Assessments from Calculus AB ● Released AP Questions	● Quizzes ● Modified Chapter Assessments from Calculus AB ● Released AP Questions	● Quizzes ● Modified Chapter Assessments from Calculus AB ● Released AP Questions ● Final Exam
Other Assessment Evidence	● Benchmark: ○ Unit 3 Test (reflecting college placement exam)	● Benchmark: ○ Unit 3 Test (reflecting college placement exam)	● Benchmark: ○ Final Exam ● Formative:

	• Formative: ◦ Warm up/Problem of the Day ◦ Lesson ◦ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations ◦ Independent Practice/Classwork/Homework • Summative: ◦ Homework 7-1, 7-2, 7-3, 7-4, 7-5 ◦ Quiz 7-1 - 7-3, 7-4 ◦ Test 7	• Formative: ◦ Warm up/Problem of the Day ◦ Lesson ◦ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations ◦ Independent Practice/Classwork/Homework • Summative: ◦ Homework 8-1, 8-2, 8-3, 8-4, 8-5, 8-6, 8-7 ◦ Quiz 8-1 - 8-2, 8-3 - 8-5 ◦ Test 8	◦ Warm up/Problem of the Day ◦ Lesson ◦ Scaffolded Classwork/Guided Practice that require students to extend understanding to new situations ◦ Independent Practice/Classwork/Homework • Summative: ◦ Homework 9-1, 9-2, 9-3, 9-4, 9-5 ◦ Quiz 9-1 - 9-2, 9-3 - 9-4 ◦ Test 9
Resources/Materials	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links • Online Videos • Quizizz • Google Slide notes	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links • Online Videos • Quizizz • Google Slide notes	**Core Materials** • Calculus, Graphical, Numerical, Algebraic , Finney/ Demana/ Waits/ Kennedy **Supplemental Materials** • Extra Practice Homework • Schoology Links • Online Videos • Quizizz • Google Slide notes
Interdisciplinary Connections	**Epidemiology & Disease Spread (Mathematics + Health Science)** **Activity:**	• Science: NJSLS.SCI.HS.PS.3: Use integration to model physical processes like work and energy, especially in mechanical systems. NJSLS.SCI.HS.LS.2:	• Science: NJSLS.SCI.HS.PS.3: Apply calculus to model rates of change in natural systems (e.g., population growth, radioactive decay).

	Students use the **SIR (Susceptible-Infected-Recovered) model** to analyze disease spread in a population. They simulate different infection rates and vaccination strategies. **NJ Standards:** ● **Mathematics (NJSLS-M)** ○ F-LE.1b: Interpret functions that model real-world data. ● **Science (NJSLS-S)** ○ HS-LS2-8: Evaluate evidence for group behavior impacting populations. ● **Health & Physical Education (NJSLS-CHPE)** ○ 2.1.12.CHSS.1: Analyze the opportunities available at home, in school, and in the community to support the mental health of oneself or an individual. .	Apply mathematics to model biological processes involving growth, decay, and resource management. ○ Understand and apply the concept of definite integrals to calculate accumulated quantities such as area, distance, and total accumulation. ○ Use definite integrals to model real-world problems, such as area under a curve, distance traveled, and work done. ○ Work collaboratively to solve problems that require applying definite integrals in physics, economics, and biology. ○ Develop skills in interpreting the results of definite integrals in the context of real-world applications.	NJSLS.SCI.HS.LS.3: Use integrals to model the accumulation of quantities, such as area under curves in biological systems. ○ Students will learn how to apply L'Hopital's Rule to evaluate limits with indeterminate forms and understand improper integrals as a tool for calculating the area under curves when limits involve infinite boundaries or discontinuities. They will then apply these concepts to a real-world problem in environmental science.

Learning Activities	• Homework Check • Learn/Lesson • Classwork/Homework	• Homework Check • Learn/Lesson • Classwork/Homework	• Homework Check • Learn/Lesson • Classwork/Homework
21st Century Skills Integration: Career Readiness, Life Literacies, and Key Skills	• 9.1.12.CFR.1: Compare and contrast the role of philanthropy, volunteer service, and charities in community development and quality of life in a variety of cultures. • 9.1.12.CFR.2: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions. • 9.1.12.CFR.3: Research companies with corporate governance policies supporting the common good and human rights. • 9.1.12.CFR.4: Demonstrate an understanding of the interrelationships among attitudes, assumptions, and patterns of behavior regarding money, saving, investing, and work across cultures. • 9.1.12.CFR.5: Summarize the purpose and importance of estate planning documents (e.g., will, durable power of attorney, living will, health care proxy, etc.). • 9.1.12.CFR.6: Identify and explain the consequences of breaking federal and/or state employment or financial laws. • 9.1.12.CDM.1: Identify the purposes, advantages, and disadvantages of debt. • 9.1.12.CDM.2: Compare and contrast the advantages and disadvantages of various types of mortgages. • 9.1.12.CDM.3: Determine ways to leverage debt beneficially. • 9.1.12.CDM.4: Identify issues associated with student loan debt, requirements for repayment, and consequences of failure to repay student loan debt. • 9.1.12.CDM.5: Identify the types of characteristics of predatory lending practices and the importance of collateral (e.g., payday loans, car title loans, high-risk mortgages). • 9.1.12.CDM.6: Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit. (e.g., student loans, credit cards, auto loans, mortgages, etc.). • 9.1.12.CDM.7: Calculate a mortgage payment based on type of loan, down payment, credit score, and loan interest rate. • 9.1.12.CDM.8: Compare and compute interest and compound interest and develop an amortization table using business tools. • 9.1.12.CDM.9: Summarize the causes and consequences of personal and corporate bankruptcy and evaluate the implications for self and others. • 9.1.12.CDM.10: Determine when credit counseling is necessary and evaluate the resources available to assist consumers who wish to use it. • 9.1.12.CP.1: Summarize how one’s credit history can affect finances, including loan terms, employment, and qualifying for loans.		

	• 9.1.12.CP.2: Identify the advantages of maintaining a positive credit history. • 9.1.12.CP.3: Summarize factors that affect a positive credit rating, including on-time payments, debt versus available credit, length of open credit, and how often you apply for credit. • 9.1.12.CP.4: Identify the skill sets needed to build and maintain a positive credit profile. • 9.1.12.CP.5: Create a plan to improve and maintain an excellent credit rating. • 9.1.12.CP.6: Explain the effect of debt on a person's net worth. • 9.1.12.CP.7: Summarize factors that affect a particular credit scoring system. • 9.1.12.CP.8: Identify different ways you can protect your credit. • 9.1.12.CP.9: Analyze the information contained in a credit report, how scores are calculated and used, and explain the importance of disputing inaccurate entries. • 9.1.12.EG.1: Review the tax rates on different sources of income and on different types of products and services purchased. • 9.1.12.EG.2: Explain why various forms of income are taxed differently. • 9.1.12.EG.3: Explain how individuals and businesses influence government policies. • 9.1.12.EG.4: Explain the relationship between your personal financial situation and the broader economic and governmental policies. • 9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities. • 9.1.12.EG.6: Analyze the rights and responsibilities of buyers and sellers under consumer protection laws. • 9.1.12.FI.1: Identify ways to protect yourself from identify theft • 9.1.12.FI.2: Explain ways to manage your accounts that maximize benefits and provide you with the utmost protection. • 9.1.12.FI.3: Develop a plan that uses the services of various financial institutions to prepare for long term personal and family goals (e.g., college, retirement). • 9.1.12.FI.4: Research benefits and drawbacks of products offered by financial and non-financial companies (e.g., banks, credit unions, check-cashing stores, product warranty insurance). • 9.1.12.FP.1: Create a clear long-term financial plan to ensure its alignment with your values. • 9.1.12.FP.2: Explain how an individual's financial values and goals may change across a lifetime and the adjustments to the personal financial plan that may be needed. • 9.1.12.FP.3: Relate the concept of delayed gratification (i.e., psychological distance) to meeting financial goals, investing and building wealth over time. • 9.1.12.FP.4: Identify how unconscious beliefs like "money scripts" (money avoidant, money worship, money status, money vigilant) influence financial decision-making.

	• 9.1.12.FP.5: Evaluate how behavioral bias (e.g., overconfidence, confirmation, recency, loss aversion, etc.) affects decision-making. • 9.1.12.FP.6: Evaluate the relationship of familial patterns, cultural traditions, and historical influences on financial practice. • 9.1.12.FP.7: Determine how multiple sources of objective, accurate and current financial information affect the prioritization of financial decisions (e.g., print information, prospectus, certified financial planners, internet, sales representatives, etc.). • 9.1.12.PB.1: Explain the difference between saving and investing. • 9.1.12.PB.2: Prioritize financial decisions by considering alternatives and possible consequences. • 9.1.12.PB.3: Design a personal budget that will help you reach your long-term and short-term financial goals. • 9.1.12.PB.4: Explain how you would revise your budget to accommodate changing circumstances. • 9.1.12.PB.5: Analyze how changes in taxes, inflation, and personal circumstances can affect a personal budget. • 9.1.12.PB.6: Describe and calculate interest and fees that are applied to various forms of spending, debt and saving. • 9.1.12.RM.1: Describe the importance of various sources of income in retirement, including Social Security, employer-sponsored retirement savings plans, and personal investments. • 9.1.12.RM.2: Identify types of investments appropriate for different objectives such as liquidity, income, and growth. • 9.1.12.RM.3: Compare the cost of various types of insurance (e.g., life, homeowners, motor vehicle) for the same product or service, strategies to lower costs, and the process for filing an insurance claim. • 9.1.12.RM.4: Determine when and why it may be appropriate for the government to provide insurance coverage rather than private industry. • 9.1.12.RM.5: Explain what self-insuring is and determine when it is appropriate. • 9.1.12.RM.6: Differentiate the costs benefits and features (e.g., riders, deductibles, umbrella policies) of renter's and homeowner's insurance. • 9.1.12.RM.7: Evaluate individual and family needs for insurance protection using opportunity -cost analysis to determine if the amount of protection is adequate or over -insured. • 9.2.12.CAP.1: Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession. • 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. • 9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment. • 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a). • 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

	• 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3). • 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a). • 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. • 9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments. • 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6). • 9.1 Standards Link - https://www.nj.gov/education/standards/clicks/Docs/2020NJSLS-9.1FinancialLiteracy.pdf • 9.2 Standards Link - https://www.nj.gov/education/standards/clicks/Docs/2020NJSLS-9.2CareerAwareness.pdf • 9.4 Standards Link - https://www.nj.gov/education/standards/clicks/Docs/2020NJSLS-9.4LifeLiteraciesandKeySkills.pdf • Our CTE offerings are extensive at the HS level. Currently, we offer 8 CTE programs at Vernon Township High School including: Engineering, Hospitality, Allied Health, Marketing, Construction, Computer Science, Cosmetology, and Graphic Design. • ARTSTANDING is a district-wide event that allows all "Special" areas to be highlighted -- of which CTE programs and Career Pathways are included.

Career Education with Diversity, Equity, and Inclusion	• Engineering
	  ○ Civil, Mechanical, Electrical, Aerospace, Chemical
	• Physicist
	  ○ Dr. Sylvester James Gates Jr. (often called S. James Gates) is an award-winning theoretical physicist best known for his work on supersymmetry, string theory, and supergravity—some of the most complex and cutting-edge areas of physics.
	• Mathematician/Statistician
	• Computer Science/Software Engineer
	• Astronomer
	  ○ Dr. Neil deGrasse Tyson is a prominent astrophysicist, author, and science communicator. He is best known for his work in the field of astrophysics and his ability to make complex scientific concepts accessible to the public. He is the director of the Hayden Planetarium at the American Museum of Natural History in New York City.
	• Actuary
	• Environmental Scientist
	• Economist
	• Financial Analyst

	● Aerospace Engineer/Pilot ● Urban Planner/Civil Engineer ● Pharmacologist/Biochemist ○ Dr. Namandjé Bumpus is a renowned African-American pharmacologist and molecular pharmacologist. She currently serves as the Chief Scientist at the U.S. Food and Drug Administration (FDA)—the first Black woman to hold this position.
Diversity, Equity, and Inclusion	**Culturally Relevant Problem-Solving** ● Design word problems that incorporate scenarios, names, and settings from various cultures and backgrounds. For example, calculate the rate of growth of a traditional festival's attendance over time or model the spread of a cultural phenomenon using differential equations. **Collaborative Group Projects with Diverse Perspectives** ● Assign group projects where students must tackle real-world problems using calculus, such as optimizing resource distribution in underserved communities or modeling equitable access to services. ● Ensure groups are diverse, encouraging students to share unique perspectives and problem-solving approaches. **Analysis of DEI Data Using Calculus** ● Use real-world data to model and analyze trends in DEI metrics, such as the rate of change in representation of underrepresented groups in STEM fields over time. ● Students can apply derivative concepts to determine acceleration or deceleration in progress toward equity goals. **Inclusive Teaching Practices and Classroom Environment** ● Learn and correctly pronounce each student's name, acknowledging its cultural significance. ● Display diverse mathematical achievements and contributions from various cultures and backgrounds. ● Implement teaching strategies that cater to diverse learning styles, such as visual aids, collaborative discussions, and hands-on activities. **Exploration of Historical Contributions to Calculus**

	• Assign research projects where students explore the lives and work of mathematicians and scientists from underrepresented groups who have contributed to the development of calculus, such as Mary Jackson, Katherine Johnson, or Srinivasa Ramanujan. • Encourage presentations that share these stories, emphasizing the global and multicultural roots of mathematical discoveries.
Technology Integration: Computer Science and Design Thinking	• Course catalog includes CTE programs such as Engineering, Computer Science, and Graphic Arts to provide technological opportunities to prepare for careers • All students are one-to-one with Chromebooks for day-to-day use in the classroom • All students log onto computers where they utilize a variety of instructional and online tools to enhance their classroom instruction as well as aid in the problem solving process • Many of the concepts that are explored in the high school mathematics curriculum involve solving problems using a step by step process and are eventually summarized using and algorithm • All classrooms have access to an interactive Smart Board with speaker system so lessons can include video, sound, and interactive lessons for all learners • TECH.8.1.8 All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. • TECH.8.1.8.A.CS1 Understand and use technology systems. • TECH.8.1.8.A.CS2 Select and use applications effectively and productively. • TECH.8.1.8.C Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. • TECH.8.1.8.C.CS1 Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media. • TECH.8.1.8.F Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. • TECH 8.2.12.D.1 Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review • TECH 8.1.12.A.2 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 are for review • TECH 8.1.12.A.CS2 Select and use applications effectively and productively • 8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor). • 8.2.12.NT.1: Explain how different groups can contribute to the overall design of a product.
Differentiation and Accommodations for:	• Special Education modifications will be implemented as per the Individualized Education Programs of the students in the class. • Such as:

Special Education and 504	○ Use of calculator, graphing calculator, desmos calculator (on chromebook) ○ Manipulatives - base blocks, algebra tiles, etc. ○ Graph Paper ● Please click here for an overview of the variety of accommodations set in place for IEP's and 504's ● Accommodations will be dictated by the general makeup of the class.
MTSS/RTI	● The VTSD Response to Intervention and MTSS Manual and the NJTSS Early Reading Screening Guidelines outline the policies and procedures that 'exist to ensure a coordinated system for planning, delivering, measurement, and modification of intervention and referral services implemented in each school by a multidisciplinary team to address the learning, behavioral, and health needs of all students. (N.J.A.C. 6A:16-8)' This requirement is fulfilled through the district New Jersey Tiered System of Support (NJTSS) Early Reading grant initiative and our Multi-Tiered Systems of Support (MTSS) Response to Intervention plan which includes ○ a. A continuum of supports and interventions available in each school to support learning, behavior, and health needs; ○ b. Action plans for interventions based on student data and desired outcomes; ○ c. Professional development for multidisciplinary teams and staff who provide interventions; and ○ d. Review and assessment of effectiveness of interventions (e.g., progress monitoring).
English Language Learners	● Coordinate activities with ESL teacher to accommodate individual learning needs ● Provide appropriate leveled texts ● Students complete the ACCESS 2.0 test yearly to measure growth and guide instruction
Risk for School-Failure	● Credit Retrieval Programs ● Apex - virtual ● Viking Success Academy ● Counseling interventions ● Parent meetings ● Student meetings ● Individual and Group counseling
Gifted and Talented Learners	● Inclusive Identification process that depicts the child as a whole in order to provide the best learning environment possible for each student. Click here for Identification Profile Sample ● Tiered Services utilizing NAGC K-12 Programming standards to ensure individual needs are being met. Click here for services map. ● Formative Assessment utilized in order to promote acceleration, curriculum compacting, grouping, and asynchronous learning where appropriate. ● Dynamic Model for Gifted Program Improvement is utilized in order to verify that our program is employing not only up to date methods, but also effective ones. ● Teacher training in Gifted Education.

Climate Change	● The following standards will be implemented in the topics that discuss using functions, specifically in units 1, 5, and 7. ● F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. Climate Change Example: Students may use function notation to determine the amount of carbon dioxide produced by burning a given number of molecules of ethane (gasoline), m, where c(m) is the number of molecules of carbon dioxide. ● F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function. Climate Change Example: Students may relate the domain of a function c(m) representing the amount of carbon dioxide produced by burning m molecules of ethane (gasoline), to its graph in order to determine the appropriate domain for c(m). ● F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. Climate Change Example: Students may calculate the average rate of change of a function c(m) presented symbolically or as a table, where c(m) represents the amount of carbon dioxide produced by burning a given number of molecules of ethane (gasoline). ● S.ID.B.6a Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models. Climate Change Example: Students may use linear or exponential functions fitted to geoscience data to solve problems and analyze the results from global climate models to make an evidence-based forecast of the current rate of global climate change.