Week	Marking Period 1	Week	Marking Period 3
1	Review Algebra & PreCalculus	11	Extrema
	Review Algebra & PreCalculus		Mean value theorem
2	Review Algebra & PreCalculus	12	First derivative test (increase/decrease)
	Review Algebra & PreCalculus		Second derivative test (concavity)
3	One-sided & two-sided limits graphically involving discontinuities	13	Optimization
	One-sided & two-sided limits graphically involving infinity		Related rates
4	Limits analytically	14	Indefinite integral using power rule
	Continuity		Indefinite integral of logarithmic & exponential functions
5	Definition of the derivative	15	Indefinite integral of trigonometric functions
	Average & instantaneous rates of change		Integration by substitution
Week	Marking Period 2	**Week**	Marking Period 4
6	Tangent & normal lines	16	Integration by parts
	Differentiability		Area under the curve & trapezoidal rule
7	Power rule and higher order derivatives	17	Definite integral
	Product rule		Mean value theorem
8	Quotient rule	18	Area between curves
	Derivatives of trigonometric functions		Volume by disks & washers
9	Chain rule	19	Volume by cylindrical shells
	Derivatives of the inverse trigonometric functions		Volume of solids with known cross sections
10	Derivatives of exponential & logarithmic functions	20	Review for final exam
	Implicit differentiation		Review for final exam

Time Frame	**Block – 10 days**

Topic

UNIT 1: Review of Algebra and PreCalculus (Advanced Calculus summer assignment)

Essential Questions

1. Can the student demonstrate knowledge of the following types of functions: linear, power, polynomial, piecewise, exponential, logarithmic, logistic, rational and trigonometric?
2. Can the student represent patterns and relationships graphically, numerically, symbolically and/or verbally?
3. How can patterns, relations and functions be used to describe real-life situations?

Enduring Understandings

1. Mathematical modeling is a process to construct a mathematical framework to represent real world situations
2. Patterns and relationships can be represented graphically, numerically, symbolically and/or verbally

Alignment to NJSLS

F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.1, F-BF.3, F-BF.4, F-BF.5, F-LE.1, F-LE.5, F-TF.5, 8.1.12F.1

Key Concepts and Skills

Solving Equations and Inequalities Algebraically

- Solve linear, quadratic, exponential, logarithmic, logistic, trigonometric and rational equations & inequalities (use interval notation to represent solutions to inequalities)

Function

- Use function notation algebraically and graphically
- Determine the inverse function
- Determine the domain and range
- Evaluate the composition of functions
- Interval of increase and decrease
- Find local minima and maxima
- Determine if the function is odd or even

Linear Functions

- Graph using a point and the slope
- Determine the equation of using a point and the slope

Polynomial Functions

- Graph using roots, minima, maxima, y-intercept, end behavior model, multiplicity, domain/range, intervals of increase and decrease
- Determine the equation of using roots, multiplicity and end behavior model
- Simplify expressions using algebraic techniques

Piecewise Functions

- Graph
- Determine the equation of given graph
- Evaluate when given a value of x
- Find x when given a value of y
- Determine if the function is continuous

Rational Functions

- Determine the points of discontinuity, x-intercept(s), y-intercept, hole(s), vertical asymptote(s), horizontal asymptote and oblique asymptote
- Graph using its characteristics

Exponential, Logarithmic and Logistic Functions

- Determine the asymptotes, domain, range, x-intercept(s) and y-intercept
- Graph using its characteristics
- Evaluate when given a value of x
- Find x when given a value of y

Trigonometric Functions

- Evaluate expressions involving trigonometric and inverse trigonometric functions
- Graph sinusoids
- Solve problems involving right triangle trigonometry

Implicitly Defined Functions

- Graph implicitly defined functions

Learning Activities

1. Review Advanced Calculus Summer Assignment
2. Note Taking – students actively engaged with teacher in conversation about concepts and ideas, continuously questioning and practicing during this process
3. Think Pair Share – students work together by taking a moment to gather their thoughts and share them with their peers
4. Technology – students use their graphing calculator and graphing software as tools to support and/or explore solutions graphically, analytically and numerically

Assessments

1. Graded homework for completeness and/or accuracy and notebook checks
2. Class Participation
3. Sectional quizzes
4. Chapter test
5. Exit tickets
6. Kahoot.com and PollEverywhere.com

21st Century Skills							
x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
	Life & Career Skills		Information Literacy	x	Media Literacy		

Interdisciplinary Connections

Solve problems in physics and social sciences

Technology Integration

1. Smartboard
2. TI-84 graphing calculator
3. Desmos and Wolfram (Google Chromebook or smartphone)
4. Remind.com (for distributing materials, resources and assignments to student)
5. Internet (YouTube.com, Kahoot.com, KhanAcademy.com, etc.)

Time Frame	**Block – 15 days**

Topic

UNIT 2: Limits and Continuity

Essential Questions

1. What is the limit of a function?
2. How can we evaluate limits numerically, graphically and analytically?
3. How can limits be used to analyze functions?
4. What are the behaviors that would cause nonexistence of a limit?
5. How is the derivative defined and what does this mean geometrically?
6. How are average and instantaneous rates of change related?
7. How do we find the equation of the tangent line?

Enduring Understandings

1. Limits can be used to analyze functions numerically, graphically and analytically.
2. Functions can behave differently at different points in their domain.
3. A function's continuity can be determined using limits.
4. Tangent lines to curves determine an instantaneous rate of change.

Alignment to NJSLS

F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.3, F-BF.4, F-BF.5, F-LE.1, F-LE.5, F-TF.5, 8.1.12F.1

Key Concepts and Skills

Find limits by direct evaluation

- Evaluate limits of polynomial, rational and trigonometric functions

Find one-sided and two-sided limits graphically

- Evaluate limits of functions involving absolute value and piecewise functions

Find one-sided and two-sided limits involving infinity

- Evaluate limits of rational (using asymptotes), polynomial (using end behavior model), exponential and trigonometric functions

Find limits analytically

- Evaluate limits of piecewise, rational (by factoring, simplifying or using the conjugate) and trigonometric functions algebraically

Continuity

- Define continuity formally and informally
- Identify the different types of discontinuities (infinite, removable, jump and oscillating)
- Find the intervals on which a function is continuous
- Apply the Intermediate Value Theorem

Average Rate of Change

- Calculate the average rate of change of a function over the given interval
- Find the equation of the secant line

Definition of a Derivative

- Use the definition of the derivative to find the derivative of a function (linear, quadratic, rational and square root) with respect to x
- Calculate the instantaneous rate of change at a point of a function
- Find the equation of the tangent and normal lines at a point of a function

Learning Activities

1. Exploration – unique challenges to study concepts as reinforcement and/or study concepts not yet formally covered
2. Note Taking – students actively engaged with teacher in conversation about concepts and ideas, continuously questioning and practicing during this process
3. Think Pair Share – students work together by taking a moment to gather their thoughts and share them with their peers
4. Technology – students use their graphing calculator and graphing software as tools to support and/or explore solutions graphically, analytically and numerically

Assessments

1. Graded homework for completeness and/or accuracy and notebook checks
2. Class Participation
3. Sectional quizzes
4. Chapter test
5. Exit tickets
6. Kahoot.com and PollEverywhere.com

21st Century Skills

x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
	Life & Career Skills		Information Literacy	x	Media Literacy		

Interdisciplinary Connections

Solve problems in physics and social sciences

Technology Integration

1. Smartboard
2. TI-84 graphing calculator
3. Desmos and Wolfram (Google Chromebook or smartphone)
4. Remind.com (for distributing materials, resources and assignments to student)
5. Internet (YouTube.com, Kahoot.com, KhanAcademy.com, etc.)

Time Frame	**Block – 15 days**

Topic

UNIT 3: Differentiation

Essential Questions

1. How does the derivative relate to the concept of change?
2. How can the rate of change of a function help develop the graph?
3. What does a derivative represent?
4. How can the derivative be found using analytic methods?
5. What are the derivative rules for functions?

Enduring Understandings

1. The relationship between a function and its derivative can be explored utilizing various methods (analytical, graphical and numerical).

Alignment to NJSLS

F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.3, F-BF.4, F-BF.5, F-LE.1, F-LE.3, F-LE.5, F-TF.5, F-TF.6, 8.1.12F.1

Key Concepts and Skills

Differentiability

- Determine if a function is differentiable at a value of x and determine the reason why it might fail to exist at a value of x (discontinuities, vertical tangents, corners and cusps)
- Differentiability implies continuity, but continuity does not imply differentiability
- Graph the derivative given the graph of the original function and vice versa

Power Rule

- Calculate the derivative of polynomial functions and functions with radicals using the power rule
- Write the first derivative using proper notation

Higher Order Derivatives

- Calculate the second, third and fourth derivative of a polynomial function using the power rule
- Write the second, third and fourth derivative using proper notation

Product, Quotient and Chain Rule

- Calculate the derivative of a function using the product, quotient and chain rule

Trigonometric and Inverse Trigonometric Functions

- Calculate the derivative of the six basic trigonometric and six inverse trigonometric functions

Exponential and Logarithmic Functions

- Calculate the derivative of exponential and logarithmic functions with base e and base not equal to e

Implicit Differentiation

- Calculate the derivative of equations that are described by complicated equations that are difficult or impossible to solve for y

Learning Activities

1. Exploration – unique challenges to study concepts as reinforcement and/or study concepts not yet formally covered
2. Note Taking – students actively engaged with teacher in conversation about concepts and ideas, continuously questioning and practicing during this process
3. Think Pair Share – students work together by taking a moment to gather their thoughts and share them with their peers
4. Technology – students use their graphing calculator and graphing software as tools to support and/or explore solutions graphically, analytically and numerically

Assessments

1. Graded homework for completeness and/or accuracy and notebook checks
2. Class Participation
3. Sectional quizzes
4. Chapter test
5. Exit tickets
6. Kahoot.com and PollEverywhere.com

21st Century Skills

x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
	Life & Career Skills		Information Literacy	x	Media Literacy		

Interdisciplinary Connections

Solve problems in physics and social sciences

Technology Integration

1. Smartboard
2. TI-84 graphing calculator
3. Desmos and Wolfram (Google Chromebook or smartphone)
4. Remind.com (for distributing materials, resources and assignments to student)
5. Internet (YouTube.com, Kahoot.com, KhanAcademy.com, etc.)

Time Frame	**Block – 15 days**

Topic

UNIT 4: Applications of Differentiation

Essential Questions

1. How can derivatives help us solve real life application problems?
2. What does the first and second derivative tell us about a function?
3. What does the concavity of a curve determine?
4. What do horizontal tangent lines represent?
5. How can functions and their derivatives be used to minimize or maximize situations?

Enduring Understandings

1. Derivatives are used to solve real life problems involving maximizing or minimizing quantities in both physical and social sciences

Alignment to NJSLS

F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.3, F-BF.4, F-BF.5, F-LE.1, F-LE.3, F-LE.5, F-TF.5, F-TF.6, 8.1.12F.1

Key Concepts and Skills

Curve Sketching

- Find the absolute and local extrema using derivatives
- Apply the Extreme Value Theorem
- Apply the Mean Value Theorem
- Apply Rolle's Theorem
- Apply the First Derivative Test for Local Extrema
- Apply the Second Derivative Test for Local Extrema
- Determine when a function is increasing or decreasing using the derivative
- Find critical points
- Find points of inflection
- Find the concavity of a function given a value of x

Optimization

- Find the minimum or maximum by finding a function to model a situation and then calculate the derivative

Related Rates

- Use derivatives to solve problems that involving objects that are moving

Learning Activities

1. Exploration – unique challenges to study concepts as reinforcement and/or study concepts not yet formally covered
2. Note Taking – students actively engaged with teacher in conversation about concepts and ideas, continuously questioning and practicing during this process
3. Think Pair Share – students work together by taking a moment to gather their thoughts and share

them with their peers
4. Technology – students use their graphing calculator and graphing software as tools to support and/or explore solutions graphically, analytically and numerically

Assessments

1. Graded homework for completeness and/or accuracy and notebook checks
2. Class Participation
3. Sectional quizzes
4. Chapter test
5. Exit tickets
6. Kahoot.com and PollEverywhere.com

21st Century Skills

x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
	Life & Career Skills		Information Literacy	x	Media Literacy		

Interdisciplinary Connections

Solve problems in physics and social sciences

Technology Integration

1. Smartboard
2. TI-84 graphing calculator
3. Desmos and Wolfram (Google Chromebook or smartphone)
4. Remind.com (for distributing materials, resources and assignments to student)
5. Internet (YouTube.com, Kahoot.com, KhanAcademy.com, etc.)

Time Frame	**Block – 15 days**

Topic

UNIT 5: Integrals

Essential Questions

1. How can you find the area of a bounded region using integration?
2. How do we find the antiderivative analytically?
3. What are the different methods for integration?
4. What is the Fundamental Theorem of Calculus?

Enduring Understandings

1. There are different methods of integration.
2. Distance can be visualized as area under the curve.
3. Derivatives and integrals are related.

Alignment to NJSLS

F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.3, F-BF.4, F-BF.5, F-LE.1, F-LE.5, F-TF.5, 8.1.12F.1

Key Concepts and Skills

Indefinite Integration

- Calculate the integral of polynomials and expressions involving radicals by applying the power rule
- Calculate the integral of logarithmic and exponential functions
- Calculate the integral of trigonometric functions
- Calculate the integral of inverse trigonometric functions

Methods of Integration

- Calculate the integral of functions (power rule, logarithmic, exponential, trigonometric and inverse trigonometric) by using substitution
- Calculate the integral of functions by using integration by parts

Definite Integration

- Calculate the approximate area under a curve using LRAM, MRAM, RRAM and the Trapezoidal Rule
- Calculate the value of a definite integral using The Fundamental Theorem of Calculus and the graph of the function
- Discover the properties of definite integrals by analyzing the area under a curve
- Calculate the value of a definite integral using substitution with change of variables
- Apply the Mean Value of Definite Integrals

Learning Activities

1. Exploration – unique challenges to study concepts as reinforcement and/or study concepts not yet formally covered
2. Note Taking – students actively engaged with teacher in conversation about concepts and ideas, continuously questioning and practicing during this process
3. Think Pair Share – students work together by taking a moment to gather their thoughts and share

them with their peers

4. Technology – students use their graphing calculator and graphing software as tools to support and/or explore solutions graphically, analytically and numerically

Assessments

1. Graded homework for completeness and/or accuracy and notebook checks
2. Class Participation
3. Sectional quizzes
4. Chapter test
5. Exit tickets
6. Kahoot.com and PollEverywhere.com

21st Century Skills

x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
	Life & Career Skills		Information Literacy	x	Media Literacy		

Interdisciplinary Connections

Solve problems in physics and social sciences

Technology Integration

1. Smartboard
2. TI-84 graphing calculator
3. Desmos and Wolfram (Google Chromebook or smartphone)
4. Remind.com (for distributing materials, resources and assignments to student)
5. Internet (YouTube.com, Kahoot.com, KhanAcademy.com, etc.)

Time Frame	**Block – 10 days**

Topic

UNIT 6: Applications of Integration

Essential Questions

1. How can we find the area between curves using integration?
2. How can we find the volume of solids using integration?

Enduring Understandings

1. Integrals can be used to find the area between curves.
2. Integrals can be used to find the volume of solids.

Alignment to NJSLS

F-IF.1, F-IF.2, F-IF.4, F-IF.5, F-IF.6, F-IF.7, F-IF.8, F-IF.9, F-BF.3, F-BF.4, F-BF.5, F-LE.1, F-LE.5, F-TF.5, 8.1.12F.1

Key Concepts and Skills

Area

- Calculate the area under a curve
- Calculate the area between curves

Volume

- Calculate the volume of solids by slicing (disks and washers)
- Calculate the volume of solids by cylindrical shells
- Calculate the volume of solids with known cross sections

Learning Activities

1. Exploration – unique challenges to study concepts as reinforcement and/or study concepts not yet formally covered
2. Note Taking – students actively engaged with teacher in conversation about concepts and ideas, continuously questioning and practicing during this process
3. Think Pair Share – students work together by taking a moment to gather their thoughts and share them with their peers
4. Technology – students use their graphing calculator and graphing software as tools to support and/or explore solutions graphically, analytically and numerically

Assessments

1. Graded homework for completeness and/or accuracy and notebook checks
2. Class Participation
3. Sectional quizzes
4. Chapter test
5. Exit tickets
6. Kahoot.com and PollEverywhere.com

21st Century Skills

x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration

	Life & Career Skills		Information Literacy	x	Media Literacy

Interdisciplinary Connections

Solve problems in physics and social sciences

Technology Integration

1. Smartboard
2. TI-84 graphing calculator
3. Desmos and Wolfram (Google Chromebook or smartphone)
4. Remind.com (for distributing materials, resources and assignments to student)
5. Internet (YouTube.com, Kahoot.com, KhanAcademy.com, etc.)