



Township of Ocean Schools

Assistant Superintendent
Office of Teaching and Learning

SPARTAN MISSION:

Meeting the needs of all students with a proud tradition of academic excellence.

DEPARTMENT: Mathematics

COURSE Advanced Calculus

Curriculum Development Timeline

School: Ocean Township High School

Course: Calculus Advanced

Department: Mathematics

Board Approval	Supervisor	Notes
June 2015	Janet Bluefield	Born Date
August 2017	Nichole Kerney	Revisions
August 2019	Nichole Kerney	Review
August 2022	Gerard Marrone	Alignment to Standards
August 2025	Greg Colon	Alignment to Standards

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Township of Ocean Pacing Guide			
Week	Marking Period 1	Week	Marking Period 3
1	Functions and Equations	21	Applications of Differentiation
2	Functions and Equations	22	Applications of Differentiation
3	Functions and Equations	23	Applications of Differentiation
4	Functions and Equations	24	Applications of Differentiation
5	Functions and Equations	25	Applications of Differentiation
6	Functions and Equations	26	Applications of Differentiation
7	Limits and Continuity	27	Integrals
8	Limits and Continuity	28	Integrals
9	Limits and Continuity	29	Integrals
10	Limits and Continuity	30	Integrals
Week	Marking Period 2	Week	Marking Period 4
11	Limits and Continuity	31	Integrals
12	Limits and Continuity	32	Integrals
13	Differentiation	33	Integrals
14	Differentiation	34	Integrals
15	Differentiation	35	Applications of Integration
16	Differentiation	36	Applications of Integration
17	Differentiation	37	Applications of Integration
18	Differentiation	38	Applications of Integration
19	Differentiation	39	Applications of Integration

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20	Differentiation	40	Applications of Integration
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Core Instructional & Supplemental Materials including various levels of Texts

Calculus AP Edition, 10th Edition, Pearson Prentice Hall © 2014
Supplemental: IXL Math

Time Frame	6 cycles ~ 18 (56 minute) days
Topic	
Functions & Equations	
Alignment to Standards	
F-IF-A.1 Understand the concept of a function and use function notation Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. F-IF-A.2 Understand the concept of a function and use function notation Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F-IF.B.4 Interpret functions that arise in application in terms of the context For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship F-IF.B.5 Interpret functions that arise in application in terms of the context Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. F-IF.B.6 Interpret functions that arise in application in terms of the context 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 F-IF.C.7 Analyze functions using different representations Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. F-IF.C.8 Analyze functions using different representations Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. F-IF.C.9 Analyze functions using different representations	

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Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

F-BF.B.3 **Build new functions from existing functions**

Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

F-BF.B.4 **Build new functions from existing functions**

Find inverse functions.

F-BF.B.5 **Build new functions from existing functions**

(+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.

F-LE.A.1 **Construct and compare linear and exponential models and solve problems**

Distinguish between situations that can be modeled with linear functions and with exponential functions.

F-LE.B.5 **Interpret expressions for functions in terms of the situation they model.**

Interpret the parameters in a linear or exponential function in terms of a context.

F-TF.B.5 **Model periodic phenomena with trigonometric functions**

Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline

Learning Objectives and Activities

SWBAT answer the following questions:

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

SWBAT demonstrate understanding of the following:

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

Learning Activities:

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

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- Evaluate and graph piecewise functions.
- Determine a piecewise equation of given graph
- Determine if the piecewise function is continuous
- For rational functions determine points of discontinuity, x-intercept(s), y-intercept, hole(s), vertical asymptote(s), horizontal asymptote and oblique asymptote
- Graph rational functions using its characteristics
- For exponential, logarithmic, and logistic functions determine the asymptotes, domain, range, x-intercept(s) and y-intercept
- Graph and evaluate exponential, logarithmic, and logistic functions using its characteristics
- Evaluate expressions involving trigonometric and inverse trigonometric functions
- Graph sinusoids
- Solve problems involving right triangle trigonometry
- Graph implicitly defined functions

Assessments

Formative:

- Anticipatory set/exit ticket
- Daily Practice Problems
- Teacher Observation
- Graphic Organizer

Summative:

- Mid-unit Quizzes
- Topic Tests

Alternative:

- Project involving graphing all functions
- PollEverywhere.com
- Individual or group productive struggle assessment during introductory lessons

Interdisciplinary Connections

Science: HS-ETS1-2: In this functions unit students will design a solution to a complex real-world problem involving maximum/minimum/projectile motion by breaking it down into smaller, more manageable problems that can be solved through engineering.

Career Readiness, Life Literacies, and Key Skills

9.1.12.CDM.6: In the logarithms unit students will describe and calculate interest and fees that are applied to various forms of spending, debt, and saving in solving equations.

Technology Integration

All students will use digital tools to access, manage, evaluate, and synthesize information in

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order to solve problems individually and collaboratively and to create and communicate knowledge.

- 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. Students will use Google Classroom to collaborate, work towards solving authentic problems, or participate in an online classroom discussion utilizing pre-learned etiquette about blended learning platforms.
- 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.

Students will use graphing calculators to use math tools strategically and attend to precision and will use Desmos in order to discover new concepts involving graphing and functions.

- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping

Career Education

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

CRP11: Use technology to enhance productivity.

Time Frame	6 cycles ~ 18 (56 minute) days
Topic	
Limits and Continuity	
Alignment to Standards	
F-IF-A.1 Understand the concept of a function and use function notation Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. F-IF-A.2 Understand the concept of a function and use function notation Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F-IF.B.4 Interpret functions that arise in application in terms of the context For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship	

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F-IF.B.5 Interpret functions that arise in application in terms of the context

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

F-IF.B.6 Interpret functions that arise in application in terms of the context

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

F-IF.C.7 Analyze functions using different representations

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F-IF.C.8 Analyze functions using different representations

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

F-IF.C.9 Analyze functions using different representations

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

F-BF.B.3 Build new functions from existing functions

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Find inverse functions.

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(+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.

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Distinguish between situations that can be modeled with linear functions and with exponential functions.

F-LE.B.5 Interpret expressions for functions in terms of the situation they model.

Interpret the parameters in a linear or exponential function in terms of a context.

F-TF.B.5 Model periodic phenomena with trigonometric functions

Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline

Learning Objectives and Activities

SWBAT answer the following questions:

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

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COURSE Advanced Calculus

SWBAT demonstrate understanding of the following:

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

Learning Activities:

Finding limits

- Find one-sided and two-sided limits graphically
- Evaluate limits of polynomial, rational and trigonometric functions
- 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
- 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

Assessments

Formative:

- Classwork and Homework
- Teacher Observation
- Class Debate of Approaches/Mathematical Methods
- Math Scavenger Hunt/Trail

Summative:

- Mid-unit Quizzes
- Topic Tests

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- Problem-based Quiz/Test on Application

Alternative:

- Exploration – unique challenges to study concepts as reinforcement and/or study concepts not yet formally covered
- Observation Assessment with Problem-solving

Interdisciplinary Connections

Career Readiness, Life Literacies, and Key Skills

9.1.12.CDM.8: When learning exponential equations students will compare and compute interest and compound interest.

Technology Integration

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

- 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.

Students will use Google Classroom to collaborate, work towards solving authentic problems, or participate in an online classroom discussion utilizing pre-learned etiquette about blended learning platforms.

- 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.

Students will use graphing calculators to use math tools strategically and attend to precision and will use Desmos in order to discover new concepts involving graphing and functions.

- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping

Career Education

CRP6: Demonstrate creativity and innovation.

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

Time Frame

8 cycles ~ 24 (56 minute) days

Topic

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Differentiation

Alignment to Standards

F-IF-A.1 Understand the concept of a function and use function notation

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.

F-IF-A.2 Understand the concept of a function and use function notation

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F-IF.B.4 Interpret functions that arise in application in terms of the context

For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship

F-IF.B.5 Interpret functions that arise in application in terms of the context

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

F-IF.B.6 Interpret functions that arise in application in terms of the context

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

F-IF.C.7 Analyze functions using different representations

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F-IF.C.8 Analyze functions using different representations

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

F-IF.C.9 Analyze functions using different representations

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

F-BF.B.3 Build new functions from existing functions

Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

F-BF.B.4 Build new functions from existing functions

Find inverse functions.

F-BF.B.5 Build new functions from existing functions

(+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.

F-LE.A.1 Construct and compare linear and exponential models and solve problems

Distinguish between situations that can be modeled with linear functions and with exponential functions.

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F-LE.A.3 Construct and compare linear and exponential models and solve problems

Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F-LE.B.5 Interpret expressions for functions in terms of the situation they model

Interpret the parameters in a linear or exponential function in terms of a context.

F-TF.B.5 Model periodic phenomena with trigonometric functions

Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

F-TF.B.6 Model periodic phenomena with trigonometric functions

(+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

Learning Objectives and Activities

SWBAT answer the following questions:

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

SWBAT demonstrate understanding of the following:

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

Learning Activities:

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, Product, Quotient and Chain Rule

- Calculate the derivative of polynomial functions and functions with radicals using the power rule
- Write the first derivative using proper notation
- Calculate the derivative of a function using the product, quotient and chain rule

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

Trigonometric, Exponential, and Logarithmic Functions

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

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- 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

Assessments

Formative:

- Classwork and Homework
- Teacher Observation
- Class Debate of Approaches/Mathematical Methods
- Anticipatory set/exit ticket

Summative:

- Mid-unit Quizzes
- Topic Tests

Alternative:

- PollEverywhere.com
- Observation Assessment with Problem-solving
- Individual or group productive struggle assessment during introductory lessons

Interdisciplinary Connections

Career Readiness, Life Literacies, and Key Skills

Technology Integration

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

- 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
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Students will use Google Classroom to collaborate, work towards solving authentic problems, or participate in an online classroom discussion utilizing pre-learned etiquette about blended learning platforms.

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- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping

Career Education

CRP6: Demonstrate creativity and innovation.

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

Time Frame	6 cycles ~ 18 (56 minute) days
Topic	
Application of Differentiation	
Alignment to Standards	
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Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

F-BF.B.3 **Build new functions from existing functions**

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Find inverse functions.

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Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline

F-TF.B.6 **Model periodic phenomena with trigonometric functions**

(+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

Learning Objectives and Activities

SWBAT answer the following questions:

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

SWBAT demonstrate understanding of the following:

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

Learning Activities:

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

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- 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 involve objects in motion

Assessments

Formative:

- Teacher Observation
- Class Debate of Approaches/Mathematical Methods
- Math Scavenger Hunt/Trail
- Entrance/Exit Cards

Summative:

- Mid-unit Quizzes
- Topic Tests
- Problem-based Quiz/Test on Application

Alternative:

- PollEverywhere.com
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Interdisciplinary Connections

Career Readiness, Life Literacies, and Key Skills

Technology Integration

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- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping

Career Education

CRP2: Apply appropriate academic and technical skills.

CRP6: Demonstrate creativity and innovation.

Time Frame	8 cycles ~ 24 (56 minute) days
Topic	
Integrals	
Alignment to Standards	
F-IF-A.1 Understand the concept of a function and use function notation Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. F-IF-A.2 Understand the concept of a function and use function notation Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F-IF.B.4 Interpret functions that arise in application in terms of the context For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship F-IF.B.5 Interpret functions that arise in application in terms of the context Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. F-IF.B.6 Interpret functions that arise in application in terms of the context Calculate and interpret the average rate of change of a function (presented symbolically or as	

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DEPARTMENT: Mathematics

COURSE Advanced Calculus

a table) over a specified interval. Estimate the rate of change from a graph

F-IF.C.7 **Analyze functions using different representations**

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F-IF.C.8 **Analyze functions using different representations**

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

F-IF.C.9 **Analyze functions using different representations**

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

F-BF.B.3 **Build new functions from existing functions**

Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

F-BF.B.4 **Build new functions from existing functions**

Find inverse functions.

F-BF.B.5 **Build new functions from existing functions**

(+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.

F-LE.A.1 **Construct and compare linear and exponential models and solve problems**

Distinguish between situations that can be modeled with linear functions and with exponential functions.

F-LE.B.5 **Interpret expressions for functions in terms of the situation they model.**

Interpret the parameters in a linear or exponential function in terms of a context.

F-TF.B.5 **Model periodic phenomena with trigonometric functions**

Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline

Learning Objectives and Activities

SWBAT answer the following questions:

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

SWBAT demonstrate understanding of the following:

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

Learning Activities:

Curve Sketching

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- 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 involve objects in motion

Assessments

Formative:

- Teacher Observation
- Class Debate of Approaches/Mathematical Methods
- Math Scavenger Hunt/Trail
- Entrance/Exit Cards

Summative:

- Mid-unit Quizzes
- Topic Tests
- Problem-based Quiz/Test on Application

Alternative:

- PollEverywhere.com
- Observation Assessment with Problem-solving
- Individual or group productive struggle assessment during introductory lessons

Interdisciplinary Connections

Career Readiness, Life Literacies, and Key Skills

Technology Integration

All students will use digital tools to access, manage, evaluate, and synthesize information in

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order to solve problems individually and collaboratively and to create and communicate knowledge.

- 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. Students will use Google Classroom to collaborate, work towards solving authentic problems, or participate in an online classroom discussion utilizing pre-learned etiquette about blended learning platforms.
- 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.

Students will use graphing calculators to use math tools strategically and attend to precision and will use Desmos in order to discover new concepts involving graphing and functions.

- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping

Career Education

CRP2: Apply appropriate academic and technical skills.

CRP6: Demonstrate creativity and innovation.

Time Frame	6 cycles ~ 18 (56 minute) days
Topic	
Applications of Integration	
Alignment to Standards	
F-IF-A.1 Understand the concept of a function and use function notation Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. F-IF-A.2 Understand the concept of a function and use function notation Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F-IF.B.4 Interpret functions that arise in application in terms of the context For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship F-IF.B.5 Interpret functions that arise in application in terms of the context	

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Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

F-IF.B.6 Interpret functions that arise in application in terms of the context

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

F-IF.C.7 Analyze functions using different representations

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F-IF.C.8 Analyze functions using different representations

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Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

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F-LE.B.5 Interpret expressions for functions in terms of the situation they model.

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F-TF.B.5 Model periodic phenomena with trigonometric functions

Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline

Learning Objectives and Activities

SWBAT answer the following questions:

- How can we find the area between curves using integration?
- How can we find the volume of solids using integration?

SWBAT demonstrate understanding of the following:

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

Learning Activities:

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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

Assessments

Formative:

- Classwork and Homework
- Daily Practice Problems
- Teacher Observation
- Class Debate of Approaches/Mathematical Methods
- Anticipatory set/exit ticket

Summative:

- Mid-unit Quizzes
- Topic Tests
- Problem-based Quiz/Test on Application

Benchmark:

- Cumulative final exam with multiple choice, short answer, and extended constructed response questions.

Alternative:

- Project – Integrals in the real-world
- Individual or group productive struggle assessment during introductory lessons

Interdisciplinary Connections

ELA: W.11-12.1: When students are justifying their reasoning on short answer and extended constructed response questions they write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

Career Readiness, Life Literacies, and Key Skills

Technology Integration

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.

- 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a

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real-world problem.

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.

Students will use Google Classroom to collaborate, work towards solving authentic problems, or participate in an online classroom discussion utilizing pre-learned etiquette about blended learning platforms.

- 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.

Students will use graphing calculators to use math tools strategically and attend to precision and will use Desmos in order to discover new concepts involving graphing and functions.

- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping

Career Education

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

CRP11: Use technology to enhance productivity.

Modifications (ELL, Special Education, At-Risk Students, Gifted & Talented, & 504 Plans)

ELL:

- Work toward longer passages as skills in English increase
- Use visuals
- Introduce key vocabulary before lesson
- Teacher models reading aloud daily
- Provide peer tutoring
- Use of Bilingual Dictionary
- Guided notes and/or scaffold outline for written assignments
- Provide students with English Learner leveled readers.

Supports for Students With IEPs:

- Allow extra time to complete assignments or tests
- Guided notes and/or scaffold outline for written assignments
- Work in a small group
- Allow answers to be given orally or dictated
- Use large print books, Braille, or books on CD (digital text)
- Follow all IEP modifications

At-Risk Students:

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- Guided notes and/or scaffold outline for written assignments
- Introduce key vocabulary before lesson
- Work in a small group
- Lesson taught again using a differentiated approach
- Allow answers to be given orally or dictated
- Use visuals / Anchor Charts
- Leveled texts according to ability

Gifted and Talented:

- Create an enhanced set of introductory activities (e.g. advance organizers, concept maps, concept puzzles)
- Provide options, alternatives and choices to differentiate and broaden the curriculum
- Organize and offer flexible small group learning activities
- Provide whole group enrichment explorations
- Teach cognitive and methodological skills
- Use center, stations, or contracts
- Organize integrated problem-solving simulations
- Propose interest-based extension activities
- Expose students to beyond level texts.

Supports for Students With 504 Plans:

- Follow all the 504 plan modifications
- Text to speech/audio recorded selections
- Amplification system as needed
- Leveled texts according to ability
- Fine motor skill stations embedded in rotation as needed
- Modified or constrained spelling word lists
- Provide anchor charts with high frequency words and phonemic patterns

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