COURSE TITLE

Advanced Placement Calculus

LENGTH

Full Year

DEPARTMENT

STEM Department

SCHOOL

Rutherford High School

DATE

September 10, 2018

Initial BOE Approval Date (Born on): 6/15/2015

Advanced Placement Calculus

I. Introduction/Overview/Philosophy

AP Calculus consists of a full high school academic year that is comparable to calculus courses in colleges and universities. Upon completing Honors Precalculus as juniors, the students who take this course will continue their study of differential and integral calculus and be prepared to take the College Entrance Examination Board's Advanced Placement Calculus Examination (AB version) in the spring of their senior year.

This course is concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications. It provides a multi-representational approach to calculus, with concepts, results, and problems being expressed geometrically, numerically, analytically, and verbally. The connections among these methods of representation are also emphasized.

II. Objectives

Course Outline:

1. Functions, Graphs, and Limits
    a. Analysis of Graphs
        i. Produce graphs of functions with and without the use of technology.
        ii. Relate geometric and analytic information from graphs.
        iii. Use calculus to predict and to explain observed local and global behavior of functions.
    b. Limits of Functions (incl. one-sided limits)
        i. Demonstrate an intuitive understanding of the limiting process.
        ii. Calculate limits using algebra.
        iii. Estimate limits from graphs or tables of data.
    c. Asymptotic and Unbounded Behavior
        i. Understand asymptotes in terms of graphical behavior.
        ii. Describe asymptotic behavior in terms of limits involving infinity.
        iii. Compare relative magnitudes of functions and their rates of change. (For example, contrasting exponential growth, polynomial growth, and logarithmic growth.)
    d. Continuity as a Property of Functions
        i. Develop an intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.)
        ii. Understand continuity in terms of limits.
        iii. Demonstrate a geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem).
2. Derivatives
    a. Concept of the Derivative
        i. Present and work with derivatives graphically, numerically, and analytically.
        ii. Interpret the derivative as an instantaneous rate of change.
        iii. Define the derivative as the limit of the difference quotient.
        iv. Understand the relationship between differentiability and continuity.
    b. Derivative at a Point

i. Calculate the slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.
ii. Find the tangent line to a curve at a point and local linear approximation.
iii. Estimate the instantaneous rate of change as the limit of average rate of change.
iv. Approximate rate of change from graphs and tables of values.

c. Derivative as a Function
i. Observe corresponding characteristics of graphs of f and f '.
ii. Determine the relationship between the increasing and decreasing behavior of f and the sign of f '.
iii. Understand the Mean Value Theorem and its geometric consequences.
iv. Solve equations involving derivatives and translate verbal descriptions into equations involving derivatives and vice versa.

d. Second Derivatives
i. Observe corresponding characteristics of the graphs of f, f ', and f ".
ii. Understand the relationship between the concavity of f and the sign of f ".
iii. Recognize points of inflection as places where concavity changes.

e. Applications of Derivatives
i. Analyze curves, including the notions of monotonicity and concavity.
ii. Understand optimization, both absolute (global) and relative (local) extrema.
iii. Model rates of change, including related rates problems.
iv. Use implicit differentiation to find the derivative of an inverse function.
v. Interpret the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration.
vi. Give a geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations.

f. Computation of Derivatives
i. Demonstrate knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions.
ii. Use the basic rules for the derivative of sums, products, and quotients of functions.
iii. Use the chain rule and implicit differentiation.

3. Integrals

a. Interpretations and Properties of Definite Integrals
i. Define the definite integral as a limit of Riemann sums.
ii. Understand the integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval.
iii. Utilize the basic properties of definite integrals. (Examples include additivity and linearity.)

b. Applications of Integrals
i. Appropriately use integrals in a variety of applications to model physical, biological, or economic situations.
ii. Be able to adapt their knowledge and techniques to solve other similar application problems using the integral of a rate of change to give accumulated change or using the method of setting up an approximating Riemann sum and representing its limit as a definite integral.
iii. Find the area of a region, the volume of a solid with known cross sections, the average value of a function, and the distance traveled by a particle along a line.

c. Fundamental Theorem of Calculus
i. Use the Fundamental Theorem to evaluate definite integrals.

ii. Use the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analyses of functions so defined.

d. Techniques of Antidifferentiation
   i. Use antiderivatives that follow directly from derivatives of basic functions.
   ii. Evaluate antiderivatives by substitution of variables (including change of limits for definite integrals).

e. Applications of Antidifferentiation
   i. Find specific antiderivatives using initial conditions, including applications to motion along a line.
   ii. Solve separable differential equations and use them in modeling. In particular, study the equation y' = ky and exponential growth.

f. Numerical Approximations to Definite Integrals
   i. Use Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values.

Student Outcomes:

After successfully completing this course, the student will:

- Represent functions in a variety of ways: graphical, numerical, analytical, or verbal and understand the connections among these representations.
- Understand the meaning of the derivative in terms of a rate of change and local linear approximation and be able to use derivatives to solve a variety of problems.
- Understand the meaning of the definite integral both as the limit of Riemann sums and as the net accumulation of a rate of change and should be able to use integrals to solve a variety of problems.
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- Communicate mathematics both orally and in well-written sentences and explain solutions to problems.
- Model a written description of a physical situation with a function, a differential equation, or an integral.
- Use technology to help solve problems, experiment, interpret results, and verify conclusions.
- Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

New Jersey Student Learning Standards

CAREER READY PRACTICES

CRP1 Act as a responsible and contributing citizen and employee.

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

CRP2 Apply appropriate academic and technical skills.

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world

applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation

CRP4 Communicate clearly and effectively and with reason.
Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

CRP6. Demonstrate creativity and innovation.
Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

CRP7. Employ valid and reliable research strategies.
Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

CRP11. Use technology to enhance productivity.
Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

TECHNOLOGY
Standard 8.1 Educational Technology: 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.
Strand C. Communication and Collaboration: 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.
8.1.12.C.1- Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

Strand F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
8.1.12.F.1- Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

Standard 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
Strand A. The Nature of Technology: Creativity and Innovation Technology systems impact every aspect of the world in which we live.
8.2.12.A.2- Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
Strand E. Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.
8.2.12.E.1- Demonstrate an understanding of the problem-solving capacity of computers in our world.

21ST CENTURY LIFE AND CAREERS

9.1 Personal Financial Literacy

Strand B: Money Management

9.1.12.B.1 Prioritize financial decisions by systematically considering alternatives and possible consequences.
9.1.12.B.2 Compare strategies for saving and investing and the factors that influence how much should be saved or invested to meet financial goals.

9.2 Career Awareness, Exploration, and Preparation

Strand C: Career Preparation

9.2.12.C.1 Review career goals and determine steps necessary for attainment.
9.2.12.C.2 Modify Personalized Student Learning Plans to support declared career goals.
9.2.12.C.5 Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures.

NEW JERSEY STUDENT LEARNING STANDARDS- MATH

A-APR.B.2. Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).
A-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.
A-APR.C.4. Prove polynomial identities and use them to describe numerical relationships.
A-APR.D.6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.
A-CED.A.1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
A-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A-CED.A.3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

A-CED.A.4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
A-REI.B.4. Solve quadratic equations in one variable.
A-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); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.★
A-SSE-A.1b. Interpret complicated expressions by viewing one or more of their parts as a single entity.
A-SSE-A.2. Use the structure of an expression to identify ways to rewrite it.
A-SSE-B.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★
F-BF.A.1. Write a function that describes a relationship between two quantities.
F-BF.B.3. 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. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
F-BF.B.4. Find inverse functions.
F-BF.B.5. (+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.
F-IF.B.4. 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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
F-IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
F-IF.C.7a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
F-IF.C.7b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
F-If.C.7c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
F-IF.C.7d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
F-IF.C.8a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
F-IF.C.8b. Use the properties of exponents to interpret expressions for exponential functions.
F-LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context.
F-TF.A.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
F-TF.A.2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
F-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, cosines, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.
F-TF.A.4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
F-TF.B.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

F-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.
F-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.
F-TF.C.8. Prove the Pythagorean identity sin2(θ) + cos2(θ) = 1 and use it to find sin(θ), cos(θ),or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.
F-TF.C.9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
G-GMD.A.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
G-GMD.B.4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
G-MG.A.1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
G-SRT.C.7. Explain and use the relationship between the sine and cosine of complementary angles.
G-SRT.C.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
N-CN.C.9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
N-Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
N-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
N-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
N-VM.A.3. (+) Solve problems involving velocity and other quantities that can be represented by vectors.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

III. Proficiency Levels

Advanced Placement Calculus is the fourth course in the high school AP/Honors track. Senior students with teacher recommendation who have successfully completed Honors PreCalculus may choose to take this course.

IV. Methods of Assessment

Student Assessment

The teacher will provide a variety of assessments during the course of the year. The assessment may include but is not limited to: chapter and unit tests and quizzes, teacher observations, open-ended problems, cooperative work, and homework.

Curriculum/Teacher Assessment

The teacher will provide the subject area supervisor with suggestions for changes on an ongoing basis.

V. Grouping

Advanced Placement Calculus is a homogeneously grouped course at the twelfth-grade level.

VI. Articulation/Scope & Sequence/Time Frame

Course length is one year.

VII. Resources

Texts/Supplemental Reading/References

Larson, Roland and Hostetler, Robert. Calculus-Fifth Edition. Lexington, MA: D.C. Heath and Company, 1994.

VIII. Suggested Activities

Appropriate activities are listed in the curriculum map.

IX. Methodologies

Students in this course will use technology on a daily basis in the form of a graphing calculator. Appropriate use of the calculator is empasized throughout the course, particularly in preparation for the calculator active and non-active portions of the AP Exam. Through discovery exercises and laboratory explorations, they will discover the concepts for themselves. They will take an active part in using various algebraic manipulatives in cooperative learning situations, thus applying teamwork to the learning process.

X. Interdisciplinary Connections

Connections are made to science, particularly physics and chemistry, by means of collaborative projects coordinating topics in the two subject areas. Connections are also made by the use of spreadsheets to collect, interpret and graph data. Writing assignments and portfolios strengthen the connection between mathematics and language arts literacy and fine arts.

XI. Differentiating Instruction for Students with Special Needs: Students with Disabilities, Students at Risk, English Language Learners, and Gifted & Talented Students

Differentiating instruction is a flexible process that includes the planning and design of instruction, how that instruction is delivered, and how student progress is measured. Teachers recognize that students can learn in multiple ways as they celebrate students' prior knowledge. By providing appropriately challenging learning, teachers can maximize success for all students.

Differentiating in this course includes but is not limited to:

Differentiation for Support (ELL, Special Education, Students at Risk)

- Peer mentoring on problems
- Differentiated teacher feedback on assignments
- Modeling out problems on whiteboard
- Visual aids as we project problems on whiteboard
- Study guides
- Tiered assignments
- Scaffolding of materials and assignments
- Re-teaching and review
- Guided note taking
- Exemplars of varied performance levels
- Multi-media approach to accommodating various learning styles

Differentiation for Enrichment

- Supplemental reading material for independent study
- Flexible grouping
- Tiered assignments
- Topic selection by interest
- Enhanced expectations for independent study
- Elevated questioning techniques using Webb's Depth of Knowledge matrix

XII. Professional Development

The teacher will continue to improve expertise through participation in a variety of professional development opportunities.

XII. Curriculum Map/Pacing Guide

Unit Topic	**Time Allocated**	**Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students**	**Standards**	**Assessments**
Derivatives ● Slope of tangent line ● Review all derivatives ● Implicit differentiation ● Related rates ● Relative Extrema ● Position, velocity, acceleration into higher order derivatives	4 weeks	*For Support:* Albert, Khan Academy Teacher modeling *For Enhancement:* Albert, Exploration Labs, real world problems	N-Q.1-3, N-CN.9, A-SSE.2-3, ACED.1-3, A-REI.11, FIF.5-6, F-BF.1, 3, F-TF.1-9, G-SRT.7-8, G-GMD.3 CRP1,2,4,6,7,8,11 8.1.12.F.1 8.2.12.E.1	*Formative Assessment:* Homework, Questioning, Classwork, Group work Teacher Observation *Summative Assessment* Test Derivatives, Quizzes Related Rates Relative Extrema
Derivative Theorems ● Rolle's, IVT, EVT ● Mean Value Theorem and the average value of a function ● Curve sketching ● Graph of f, f', f'' ● Limits Asymptotes ● Optimization Problems	6 weeks	*For Support:* Albert, IXL Lecture with examples with and without a graphing calculator *For Enhancement:* Albert, Real world applications, Group discovery activities	N-Q.1-3, N-CN.9, A-SSE.2-3, A-APR.3-4, A-CED.3, A-REI.11, F-IF.4-5, 7a-d, 8a, F-BF.1, F-TF.1-4, G-SRT.7-8, G-GMD.3, CRP1,2,4,6,7,8,11 8.1.12.C.1 8.2.12.A.1 9.1.12.B.1, 2	*Formative Assessment:* Homework, Questioning, Classwork, Group work Closure questions *Summative Assessment* Test All Theorems Rolle's IVT, Mean, value, Quizzes Curve sketching, Quiz Optimization Benchmark Q1

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
Antiderivatives/Indefinite Integrals ● Sums and Sigma notation ● General and particular antiderivatives ● Definite Integrals as the summation of area under a curve ● Riemann Sum calculate left, right, and midpoint sums ● Trapezoidal Rule to find area under the curve	3 weeks	*For Support:* Authentic Assessment, Pairing, Cooperative learning groups, Khan Academy *For Enhancement:* Higher order thinking skills, Albert, Real World problems, Youtube videos	N-Q.1-3, N-VM.3, ASSE.2-3, A-APR.2, 6, A-CED.1-2, A-REI.4, F-IF.7a-d, F-TF.1-4 CRP1,2,4,6,7,8,11	*Formative Assessment:* Homework, Classwork, Group Work, Closure questions *Summative Assessment* Test: Antiderivatives, quizzes Definite integrals, Riemann Sums Trapezoidal Problems
First and Second Fundamental Theorem of Calculus ● Integration by substitution and change of variables ● Area ● Initial Value Problems ● Patterns for exponential growth and decay models ● Applications to real life problems	5 weeks	*For Support:* Authentic Assessment, Teacher modeling, cooperative learning groups, pod casts reviews *For Enhancement* Independent study, higher order thinking skills, Albert, Khan Academy	F.IF.B.4, G.GMD.4 G.GMD.3, CRP1,2,4,6,7,8,11 8.2.12.A.2	*Formative Assessment:* Homework, Classwork, Group Work, Closure questions *Summative Assessment* Test Fundamental Theorem of Calculus Quizzes Area between two functions, Finding initial values, growth and decay Take home area lab quiz Benchmark Q2
Logarithmic and Exponential Functions ● Derivatives and Integrals Inverse Trig Functions ● Applications with domain restrictions	4 weeks	*For Support:* Authentic assessments, Guided notes, additional practice problems, Youtube videos, student pairing *For Enhancement:* Khan Academy, student driven activities, independent study, real	N-Q.1-3, A-SSE.2-3, A-CED.1-2, F-IF.5, 7a-d, F-BF.4-5, F-LE.5, F-TF.1-4,6 CRP1,2,4,6,7,8,11 8.1.12.F.1	*Formative Assessment:* Homework, classwork and group activities *Summative Assessment* Test on Logs and Exponential Functions Quizzes Integrating logs and derivatives of logs

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
		world applications		
Inverse trig – Derivatives and Integrals ● Trig Substitution with Mixed Integrals ● Area between two curves	4 weeks	*For Support:* Authentic Assessments, teacher modeling, guided notes, cooperative grouping *For Enhancement:* Critical/analytical tasks, Khan Academy, independent study, extension activities	N-Q.1-3, A-SSE.2-3, A-CED.1-2, F-IF.5, 7a-d, F-BF.4-5, F-LE.5, F-TF.1-4 CRP1,2,4,6,7,8,11 8.1.12.F.1	*Formative Assessment:* Classwork, group work, homework, questioning *Summative Assessment* Test Inverse Trig Quiz mixed integrals Quiz area between 2 curves
Volumes ● Volume disc method ● Volume washer method ● Volume known cross section ● Volume Shell Method	3 weeks	*For Support:* Teacher modeling, rephrasing questions, outlined notes with worked out examples, Khan Academy *For Enhancement:* Real life applications, adjusting the pace of the lesson, independent study, inquiry based instruction	N-Q.1-3, A-SSE.2-3, A-CED.1-2, A-REI.11, F-IF.7, F-BF.1, FTF.1-4, G-GMD.3-4, G-MG.1 CRP1,2,4,6,7,8,11 9.1.12.B.2	*Formative Assessment:* Labs, homework, classwork, questioning *Summative Assessment* Test all methods of finding Volume Quizzes, disc/washer Known cross sections, and shell method Project Find the volume of a bagel Benchmark Q3
Slope Fields ● Separation of Variables slope fields for given differential equations ● Match diff equation to its graph ● Formulate particular solutions to differential equations and state the domain	1 week	*For Support:* Pod cast videos, completed notes with examples, pacing, flip classroom pre-teaching *For Enhancement:* Khan Academy, higher order problems, independent work, real world applications	N-Q.1-3, A-SSE.1b-3, A-CED.1-4, F-IF.7, 8b, F-BF.5, F-LE.5, CRP1,2,4,6,7,8,11	*Formative Assessment:* Lab match equations with graphs Group work Practice Free Response AP questions Practice Multiple Choice *Summative Assessment* Test slope fields, lab graphing slope

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
				field and matching equations to the graph
AP Exam Review and Test Preparation Practice Timed Tests	4 weeks	*For Support:* Guided practice tests, group work, Khan Academy, rephrase questions, AP flash cards *For Enhancement:* Additional free response problems, accelerated pacing, pairing, Khan Academy	N-Q.1-3, N-CN.9, A-SSE.2-3, A-APR.3-4, A-CED.3, A-REI.11, F-IF.4-5, 7a-d, 8a, F-BF.1, F-TF.1-4, G-SRT.7-8, G-GMD.3, CRP1,2,4,6,7,8,11 9.2.12.C.1 9.2.12.C.2 9.2.12.C.5	*Formative Assessment:* Class work, group activities, homework, practice labs MCQ and FR, *Summative Assessment* Complete AP Practice tests
Integrations by Parts Five Labs **Long term project:** Students select a mathematician and create a research project and presentation	3 weeks	*For Support:* Note packet with samples, group pairing labs, Khan Academy *For Enhancement:* More difficult topic for long term project, Technology, Internet	N-Q.1-3, N-CN.9, A-SSE.2-3, A-APR.3-4, A-CED.3, A-REI.11, F-IF.4-5, 7a-d, 8a, F-BF.1, F-TF.1-4, G-SRT.7-8, G-GMD.3, CRP1,2,4,6,7,8,11	*Formative Assessment* Homework, Labs, classwork, questioning *Summative Assessment* Project based assessment, test and quiz: Integration by parts, Benchmark Q4