Course Information

Grade(s):	**12**
Discipline/Course:	**Mathematics**
Course Title:	**Calculus**
Prerequisite(s):	Pre-Calculus
Course Description: *Program of Studies*	Calculus course is designed for the student who has completed Pre-Calculus and wishes to be introduced to a college calculus experience. To be successful, students must be motivated learners who have mathematical intuition, a solid background in the topics studied in previous courses and the persistence to grapple with complex problems. The critical areas of focus for this course will be in three areas: (a) functions, graphs and limits, (b) differential calculus (the derivative and its applications), and (c) integral calculus (anti-derivatives and their applications). 1. Students will build upon their understanding of functions from prior mathematics courses to determine continuity and the existence of limits of a function both graphically and by the formal definitions of continuity and limits. They will use the understanding of limits and continuity to analyze the behavior of functions as they approach a discontinuity or as the function approaches $\pm\infty$. 2. Students will analyze the formal definition of a derivate and the conditions upon which a derivative exists. They will interpret the derivative as the slope of a tangent line and the instantaneous rate of change of the function at a specific value. Students will distinguish between a tangent line and a secant line. They will learn formulas and techniques to enable them to differentiate algebraic, trigonometric, inverse trigonometric, inverse, exponential and logarithmic functions. Students will apply the derivate to analyze optimization problems, related rates problems and position functions. 3. They will analyze integrals by evaluating areas under the curve. Students will use the Fundamental Theorem of calculus to evaluate Integrals using antiderivatives. They will apply integrals to problems involving area, velocity, acceleration. Lastly, students will learn techniques to integrate using substitution.

Course Essential Questions:	● What is a limit and how can it be interpreted? ● What is a derivative? ● What is an integral? ● What is Calculus?
Course Enduring Understandings:	● Formal definitions and graphical interpretations of limits and continuity ● Formal definition, application and properties of a derivative. ● Formal definition, application and properties of an integral. ● Calculus can be used to extend our mathematical boundaries. ● Calculus is the study of change.
Duration:	One Year
Course Materials/Resources:	Brief Calculus: An Applied Approach & WebAssign

***Note: Topics listed in the units may evolve over time based on adaptations to implementation. However, the overall content of the entire course will not change**

Academic Expectations The Fairfield Public Schools describe a variety of cross curricular expectations that all students should exemplify during their time within the schooling experience. This page gives examples of what the practice standards look like at the specified grade level. Students are expected to:		
Standards	Explanations	Example
1. Exploring and Understanding [MP1]	When students engage in problem solving situations, they should be able to understand the problem, determine relevant information, and ask relevant additional questions.	Students should be able to answer the following questions when approaching a problem: 1. Do you understand all the words used in stating the problem? 2. What are you asked to find or show? 3. Can you restate the problem in your own words? 4. Can you think of a picture or diagram that might help you understand the problem?
2. Synthesizing and Evaluating	Engaging in a problem solving situation, students should be able to analyze the most efficient approach, and reflect on the process used to solve the problem.	Students should be able to answer the following questions when analyzing how to approach a problem, and also reflect on the result: 1. Is there enough information to enable you to find a solution? If not, what additional information is needed? 2. Are there multiple ways to complete the task? Which approach do you think is most efficient, and why? 3. Do you know a related problem? Look at the unknown and try to think of a familiar problem having the same or similar unknown. Can you use it? 4. Was your strategy effective? What worked? What didn't? 5. Was there another approach that could have been more efficient? 6. Is your answer reasonable? How do you know? 7. Was your presentation approach effective? If not, what would you change? 8. How did the communication tools allow you to get the message across to the intended audience?

3. Creating and Constructing	Engaged in a problem solving situation, students should implement a plan.	Students should be able to answer the following question to implementing their plan to solve a problem: 1. What strategy will you use to complete the task?
4. Conveying Ideas	Students should be able to use correct mathematical language, logically display their work for the desired problem.	Students should be able to answer the following questions to convey their mathematical thinking to solve a problem: 1. How will you present your information to your intended audience? 2. Does your response illustrate the correct terms and work to the problem?
5. Using Communicatio n Tools	Students should be able to choose the correct tools to illustrate their mathematical work to solve a specific problem.	Students should be able to answer the following question to use specific communication tools to solve a problem: 1. If applicable, what communication tools will you use to convey your ideas and solution?
6. Collaborating Strategically	Students should be able to work collaboratively to solve problems.	Students should be able to answer the following question to collaboratively solve problems: 1. In what ways did you work together to help solve the desired problem?

Unit Number and Title:	Unit 1: Preparation for Calculus
Duration:	2 weeks
Resource(s):	Brief Calculus: An Applied Approach & WebAssign
Learning Goals	
Standard(s):	N/A
Essential Question(s):	How do you use the exponent properties to simplify expressions?
Enduring Understanding(s):	Knowing how to operate with radicals and exponents helps manipulate expressions in Calculus.
Learning Goal(s): *Students will be able to use their learning to:*	1. Use interval notation to describe sets of numbers. 2. Find rational zeros of a polynomial. 3. Add two rational expressions with literal numerators. 4. Use fractional and negative exponents to simplify rational expressions. 5. Simplify complex radical expressions. 6. Rationalize numerator and denominator of a fraction involving radicals with the use of conjugate.

Unit Number and Title:	Unit 2: Functions, Graphs, and Limits
Duration:	6 weeks
Resource(s):	Brief Calculus: An Applied Approach (Stewart) & WebAssign
Learning Goals	
Standard(s):	N/A
Essential Question(s):	● How do you determine a value of a function for a value that is restricted in the domain? ● How can you determine a limit of a function from different functions illustrating different continuities? ● What are one-sided limits and infinite limits?
Enduring Understanding(s):	● A concept of a limit allows you to determine the value of a function by getting really close to a specified value. ● The properties of limits follow many of the properties of real numbers. ● The type of continuity affects the limit of a function. ● Patterns can continue to infinity and yet still have a limit as to how big they can get.
Learning Goal(s): *Students will be able to use their learning to:*	1. Demonstrate knowledge of both the formal definition and the graphical interpretation of limit of values of functions. This knowledge includes one-sided limits, infinite limits, and limits at infinity. 2. Prove and use theorems evaluating the limits of sums, products, quotients, and composition of functions. 3. Use graphical calculators to verify and estimate limits. 4. Determine values of limits of a given function (e.g., a particular number, does not exist, etc.) 5. Demonstrate knowledge of both the formal definition and the graphical interpretation of continuity of a function.

Unit Number and Title:	Unit 3: Differentiation
Duration:	8 weeks
Resource(s):	Brief Calculus: An Applied Approach & WebAssign
Learning Goals	
Standard(s):	N/A
Essential Question(s):	● How can calculus and the concepts of limit and continuity assist us in analyzing the rate of change for curves? ● What is a derivative, how do we determine it, and how is it built from the limit? ● How is it possible to find the slope of a tangent line? ● How do you differentiate a polynomial function using the power rule? ● How do you differentiate a product of functions using the product rule? ● How do you differentiate a rational function using the quotient rule? ● How do you differentiate a composition of functions using the chain rule? ● How do you differentiate implicitly? ● How do you differentiate a function using related rates?
Enduring Understanding(s):	● The extension of the limit allows for the calculation of the instantaneous rate of change for any given point on a continuous function. ● There exist efficient approaches to determine the derivatives of functions.
Learning Goal(s): *Students will be able to use their learning to:*	1. Demonstrate an understanding of the formal definition of the derivative of a function at a point and the notion of differentiability: 2. Demonstrate an understanding of the derivative of a function as the slope of the tangent line to the graph of the function at a particular point.

	3. Demonstrate an understanding of the interpretation of the derivative as an instantaneous rate of change. Use derivatives to solve a variety of problems from physics, chemistry, economics, and so forth that involve the rate of change of a function. 4. Understand the relationship between differentiability and continuity. 5. Know the chain rule and applications to the calculation of the derivative of a variety of composite functions. 6. Compute derivatives of higher orders. 7. Find the derivatives of defined functions through implicit differentiation in a wide variety of problems. 8. Use differentiation to solve related rate problems in a variety of pure and applied contexts involving variables that changing in respect to time.

Unit Number and Title:	Unit 4: Applications of the Derivative
Duration:	8 weeks
Resource(s):	Brief Calculus: An Applied Approach & WebAssign
Learning Goals	
Standard(s):	N/A
Essential Question(s):	● What role does calculus play as a tool in science, business, and other areas of study? ● How is the derivative used to solve problems involving area, velocity and acceleration? ● What information can be determined from the derivative to help sketch the graph of a function?
Enduring Understanding(s):	● The use of the derivative has many applications. The calculation of the derivative allows for and efficient approach to the computation of possible maximum profit, minimum amount used, etc. ● The derivative can provide useful information on the graph of a function.
Learning Goal(s): *Students will be able to use their learning to:*	1. Use differentiation to sketch, by hand, graphs of functions. Identify maxima, minima, inflection points, and intervals in which the function is increasing and decreasing. 2. Use differentiation to solve optimization (maximum-minimum problems) in a variety of pure and applied contexts. 3. Use calculus to solve business and economics problems (e.g., price elasticity of demand, maximum revenue and profit, minimum average cost). 4. Know how asymptotes are related to an infinite limit.

Unit Number and Title:	Unit 5: Derivatives of Exponential and Logarithmic Functions
Duration:	4 weeks
Resource(s):	Brief Calculus: An Applied Approach & WebAssign
Learning Goals	
Standard(s):	N/A
Essential Question(s):	● What role does calculus play as a tool in science, business, and other areas of study? ● How is the derivative used to solve problems involving growth and decay?
Enduring Understanding(s):	● The use of the derivative has many applications. The calculation of the derivative allows for and efficient approach to the computation of possible maximum profit, minimum amount used, etc.
Learning Goal(s): *Students will be able to use their learning to:*	1. Graph exponential function f(x) = ax and f(x) = ex. 2. Calculate derivatives of exponential functions. 3. Graph logarithmic function f(x) = ln x and use it to solve exponential and logarithmic equations. 4. Calculate the derivatives of logarithmic functions.

Unit Number and Title:	Unit 6 - Integration and its Applications
Duration:	5 weeks
Resource(s):	Brief Calculus: An Applied Approach & WebAssign
Learning Goals	
Standard(s):	N/A
Essential Question(s):	● What is an integral (definite and indefinite), how can it be determined and/or evaluated? ● How is it possible to find the area under a curve? ● What is the notation for the integral? ● How do you find the integral? ● What does the integral represent? ● How is integration related to differentiation through the Fundamental Theorem of Calculus?
Enduring Understanding(s):	● The integral is the area under the curve. ● The Fundamental Theorem of Calculus is a theorem that links the concept of the derivative of a function with the concept of the integral.
Learning Goal(s): *Students will be able to use their learning to:*	1. Find the antiderivative of a function. 2. Demonstrate knowledge of the Fundamental Theorem Of Calculus and use it to interpret integrals as antiderivatives. 3. Use the general power, the exponential rule, and log rule to calculate antiderivatives (indefinite integrals). 4. Know the definition of the definite integral. 5. Evaluate definite integrals and apply the Fundamental Theorem of Calculus to find the area bounded by two graphs. 6. Apply the definition of the integral to model problems in geometry, physics, economics, and so

	forth.