AP Calculus

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Content	Skills	Learning Targets	Assessment	Resources & Technology	Standard
CEQ: **What are the roles of limits in developing calculus?** **What is the meaning of derivative as a rate of change and how can it be used to model and solve problems?** **What role do derivatives and the theorems of calculus play in connecting and understanding functions graphically, numerically, analytically and verbally?**				Calculus: **TextBook:** Tenth Edition by Larson and Edwards. **Graphical Technology:** TI- 84 plus	Course is taught following College Board guidance at this link.

UEQ: *What are the relationships between Functions and their graphs?* *What are some special functions and their applications?* **A: Foundations for Calculus** A1: Lines and Slopes A2: Functions and Graphs A3: Exponential Functions A4: Inverse Functions and Logarithms A5: Trigonometric Functions	**A: Foundations for Calculus** A1: Generate equations for lines using the slope/intercept and point/slope forms. A2: Identify functions from their graphs A2: Identify the domain and range of functions from graphs and equations including piecewise defined functions. A2: Identify situations in which graphing technology may fail in determining domains and ranges of functions. A2: Understand the relationship between the graphs of functions classified as odd or even. A2: Understanding the use of composite functions. A3: Understand the	**A: Foundations for Calculus** LT1: I can write linear equations from points, slopes and graphical representations of data. LT2: I can identify types of functions as well as their domains and ranges including, but not limited to, piecewise defined functions. LT3: I can recognize, understand, and create graphs of various functions through the use of the properties unique to different families of functions. i.e. symmetry, asymptotes and various graph transformations LT4:	**A: Foundations for Calculus** CFA -(Mid - Unit Quiz) CSA - (Unit Test)	**A: Foundations for Calculus** Required: TI 84 or Equivalent Graphing Calculator Optional: Geometer's' Sketchpad TI-Nspire Calculators	

UEQ: *What is the definition of and properties for working with limits?* *What is the connection between 2-sided limits and continuity?*	shape and uses for exponential functions and the number **e**. A4: Determine whether a function is one-to-one and whether or not an inverse exists. A4: Understand the graphical connection between a function and its inverse. A4: Use logarithms and their properties to solve equations. A5: Understand the connections between trigonometric equations and their graphs. A5: Apply graph transformations to periodic functions. A5: Identify the relationship between a trigonometric function and its inverse. A5: Explore domain restrictions as they relate to trigonometric functions.	I can use graphing technology to generate graphs of functions and draw inferences about their properties including grapher limitations. LT5: I can use function notation to combine functions with mathematical operators including composite functions. LT6: I can apply properties of inverse functions and generate graphs showing under standing of the connections between the domain and range of these functions. LT7: I can work with applications of different function families and use them to make future			

How can limits and continuity be used to determine the rate of change for a function at a given point? *(Tangent Line?)* **B: Limits and Continuity** B1: Definition and properties of Limits B2: One and Two sided limits B3: Limits involving infinity B4: Continuity and functions B5: Tangent and Normal lines	A1-5: Work with applications of each function type including exponential growth/decay, production and future projections. **B: Limits and Continuity** B1: Explore average and instantaneous speed as they relate to slope and limits. B1: Understand the definition and six properties of Limit. B1: Determine the limits of polynomials and other rational functions by graphing and confirming analytically. B2: Explore limits from the right and left handed sides. B2: Determine if a limit at a particular x-value exists by using two sided Limits. B2: Understand the	projections. **B: Limits and Continuity** LT1: I can distinguish between the average and instantaneous rates of change as they apply to slope and limits. LT2: I can use the Properties of Limits as they apply to polynomials to evaluate Limit Values. LT3: I can Determine the existence of a limit and it's value through Graphical and Analytic methods. LT4: I can determine left	**B: Limits and Continuity** CFA -(Mid - Unit Quiz) CSA - (Unit Test)	**B: Limits and Continuity** See Above	

UEQ: *What are derivatives?*	Sandwich (Squeeze) Theorem and what functions it can be applied. B3: Understand the behavior of a function's limit when it approaches positive and negative infinity. B3: Determine the horizontal asymptotes of a function, if any. B3: Apply End Behavior Models to appropriate functions. B4:. Determine a function's Continuity at a certain point. B4: Understand the properties of continuous functions. B4: Identify Continuous functions. B4: Understand composite functions in regards to continuity. B4: Understand and apply the Intermediate Value Theorem to continuous functions. B5: Understand	and right handed limits. <u>LT5</u>: I can apply end behavior models to polynomial functions to determine horizontal asymptotes. LT6: I can determine continuity at a point and expand it to identify continuous functions. LT7: I can apply continuity to composite functions. LT8: I can apply the intermediate value theorem. LT9: I can Explain the difference between a Secant and Tangent line as they relate to a curve.			

How do you find derivatives of different functions. *What are the rules for differentiation?* **C: Derivatives** C1: Definition of Derivative as a Limit. C2: Derivative at a point C3: Graphs of Derivatives and Functions C4: One-Sided Derivatives C5: Non-differentiable points C6: Intermediate Value Theorem C7: Differentiation Rules for functions C8: Velocity, Acceleration and other Rates of change. C9: Economic Applications of Derivatives	Secant Slope as the average rate of change. B5: Understand Tangent Line as the instantaneous rate of change. B5: Find the Secant and Tangent lines to a point on a curve. B1-B5: Find the instantaneous and average rates of change for various science, business applications. **C: Derivatives** C1: Apply the definition of derivative to determine the rate of change of a function at a given point. C2: Differentiate between the graph of a function and the graph of its derivative using key features. C3: Identify non-differentiable points for a function and explain why they are not differentiable.	LT 10: I can Find the Secant and Tangent lines to a point on a curve. LT 11: I can determine average and instantaneous rates of change in science and business applications. **C: Derivatives** <u>LT1</u>: I can apply the definition of derivative to determine the rate of change of a function at a given point. <u>LT2:</u> I can differentiate between the graph of a function and the graph of its derivative using key features. <u>LT3</u>: I can identify	**C: Derivatives** CFA -(Mid - Unit Quiz) CSA - (Unit Test)	**C: Derivatives** See Above	

C10: Derivatives of Trig Functions C11: Differentiation of Composite Functions (Chain Rule) C12: Implicit Differentiation C13: Derivatives of Inverse functions C14: Derivatives of Exponential and Logarithmic Functions.	C4: Apply the intermediate value theorem to determine whether a function's derivative will take on a given value. C5: Develop the rules of differentiation (Sum, Difference, Constant Multiple, Product, Quotient, and Power. C6: Apply the differentiation rules to various families of functions. C7: Discover the relationship among position, velocity and acceleration of a body in motion. C8: Apply differentiation rules to Economics (marginals) C9: Discover the differentiation rules for the trigonometric family of functions. C10: Construct the Chain Rule for differentiating compos ite functions. C11: Develop an	non-differentiable points for a function and explain why. <u>LT4:</u> I can apply the intermediate value theorem to determine whether a function's derivative will take on a given value. <u>LT5</u>: I can apply the differentiation rules to various families of functions. LT6: I can determine the relationship among position, velocity and acceleration of a body in motion. LT7: I can apply differentiation rules to Economics LT8: I can apply it the differentiation rules			

	understanding of implicit differentiation and its role in computing derivatives of equations that are not functions. C12: Examine derivatives of the inverse trigonometric functions. C13: Apply rules for computing derivatives of Exponential and Logarithmic functions. C1-13: Combine all of the derivative rules to determine locations of points where the derivative would be zero and to find the equation of Tangent and Normal Lines.	for the trigonometric family of functions.. LT9: I can use the chain rule to differentiate. LT 10: I can differentiate inver se trigonometric functions. LT 11: I can differentiate logarithmic and exponential functions. LT 12: I can locate points where Tangent values are zero and create both the Tangent and Normal equations at that point.			

CEQ: *What is the relationship between differential calculus and integral calculus?* *How can word problems and real life problems be solved through the use of calculus?* *UEQ:* *What are the extreme values of a function and how can they be calculated?* *How can extreme values and derivatives be applied to real world applications?* **D: Applications of Derivatives** D1: Extreme Values of Functions D2: Increasing and Decreasing functions. D3: First and Second Derivative tests for Extreme Values D4: Concavity and Inflection Points D5: Modeling and Optimization D5: Related Rates **UEQ:** *How does integral calculus relate to "areas under curves"?* *What is the relationship between finding slopes of tangent lines(differential calculus) and finding areas under curves(integral calculus)?*	**D: Applications of Derivatives** D1: Define the extreme values of a function D2: Appy the extreme Value Theorem to various functions and their graphs. D3: Investigate the Mean Value Theorem and its applications to graphs of functions. D4: Compare various Acceleration, velocity and position functions to develop the concept of andtidifferentiation. D5: Connect the graphs of f ' and f " to the graphs of f using first and second derivative tests. D5: Develop the concept of concavity and how to interpret this in relation to a function. D6: Solve optimization problems using first and second derivatives. D7: Combine optimization and implicit differentiation to solve problems involving related rates.	**D: Applications of Derivatives** Ch 4 Test Ch. 1-4 Final Exam (optional)	

E. The Definite Integral(Chapter 5) E1: Distance Traveled E2: Definite Integrals E3: Definite Integrals and Antiderivatives E4: Fundamental Theorem of Calculus E5: Trapezoidal Rule **UEQ:** *How are differential equations recognized, then solved?* *What are slope fields and how are they connected to differential equations?* *How is "u-substitution" used to find anti-derivatives, analytically?*	**E. The Definite Integral(Chapter 5)** E1: Explore the concept of the area under the curve as an accumulator for a velocity function. E1: Compare different techniques(RRAM, MRAM, LRAM) for estimating the area under the curve. E2: Examine the notation used to define definite integrals. E2: Investigate the use of the graphing calculator to compute indefinite integrals. E3: Investigate the properties of definite integrals. E3: Explore and understand the "Mean Value Theorem" and its uses. E3: Make a connection between differential and integral calculus. E3: Investigate how to find the derivative of an integral. E4: Learn how to apply the "Fundamental Theorem of Calculus". E4: Learn how to apply "The Fundamental Theorem of Calculus, Part 2". E4: Investigate methods for finding "total area", analytically. E5: Learn how to use the "Trapezoid Rule" to estimate the area under a curve.	**E. The Definite Integral(Chapter 5)** CFA -(Mid - Unit Quiz) CSA - (Unit Test)	

F. Differential Equations and Mathematical Modeling(Chapter 6) F1: Slope Fields and Differential Equations F2: Antidifferentiation by Substitution F3: Exponential Growth and Decay **UEQ:** *How is total distance traveled calculated?* *How is the area between curves calculated?* *What is the method for calculating volumes of solids with specific cross-sections and volumes of solids formed by revolving regions?*	**F. Differential Equations and Mathematical Modeling(Chapter 6)** F1: Investigate how to solve a differential equation. F1: Investigate how to solve an "initial value" problem. F1: Explore and construct slope fields. F2: Learn how to evaluate an "indefinite integral", analytically. F2: Investigate how to verify antiderivative formulae. F2: Develop techniques to solve definite integrals by the use of "u-substitution". F3: Explore how to solve differential equations using "separation of variables". F3: Explain how calculus is used to derive the formula for exponential growth and decay. F3: Apply the formula for exponential growth and decay to solve problems.	**F. Differential Equations and Mathematical Modeling(Chapter 6)** CFA -(Mid - Unit Quiz) CSA - (Unit Test)	
G. Applications of Definite Integrals (Chapter 7) G1: Integral as Net Change G2: Areas in the Plane G3: Volumes **UEQ:** *What are the expectations of the College Board in writing the AP Calculus Test?*	G1: Calculate the total distance traveled by a particle. G1: Analyze graphs to answer questions regarding position, velocity, acceleration, and distance traveled. G2: Develop method for finding the area between curves. G2: Learn how to integrate with respect to y. G3: Calculate volumes of solids knowing		

What advice is helpful in taking the AP Calculus Exam? **H. Review and Prepare for AP Calculus Exam.**	the shape of the cross-sections of the solid. G3: Use various techniques including "disc method, washer method, and shell method, to calculate volumes of solids formed by revolving regions on the coordinate plane.		