Teacher: CORE Calculus H
Year: 2017-18
Month: All Months
Course: Calculus H

September - Unit 1

Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
What are the most important topics and concepts needed in order to start learning calculus?	A. Lines	A1. To use increments to calculate slope. A2. To write and equation and sketch a graph of a line given specific information. A3. To identify the relationshiops between parallel lines, perpendicular lines and slopes. A4. To use linear regression equations to solve problems.	Slope Increments				2.8.A2.B-Evaluate and simplify algebraic expressions; solve and graph, quadratic, exponential, and logarithmic equations; and, solve and graph systems of equations and inequalities.
What are the most important topics and concepts needed in order to start learning calculus?	B. Functions and Graphs	B1. To identify domain and range of a functon using its graph or equation. B2. To recognize even and odd functions B3. To interpret and find formulas for piecewise defined functions. B4. To write and evaluate compositions of two functions.	Domain/range Boundary and Boundary points Even/odd functions				2.8.A2.D-Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, exponential, logarithmic).
What are the most important topics and concepts needed in order to start learning calculus?	C. Exponential Functions	C1. To determine the domain, range, and graph of an exponential function.	Exponential growth and decay				2.8.A2.B-Evaluate and simplify algebraic expressions; solve and graph, quadratic, exponential, and logarithmic equations; and, solve and graph systems of equations and inequalities.

			The number e	2.8.A2.D-Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, exponential, logarithmic).
		C2. To solve problems involving exponential growth and decay. C3. To use exponential regression equations to solve problems.		
What are the most important topics and concepts needed in order to start learning calculus?	D. Functions and Logarithms	D1. To identify a one-to-one function.	one-to-one function	2.8.A2.B-Evaluate and simplify algebraic expressions; solve and graph, quadratic, exponential, and logarithmic equations; and, solve and graph systems of equations and inequalities. 2.8.A2.D-Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, exponential, logarithmic).
		D2. To determine the algebraic representation and the graphical representation of a functio and its inverse.	Inverse Functions	
			Properties of Logarithms	
		D3. To apply the properties of logarithms. D4. To use logarithmic regression equations to solve problems.		
What are the most important topics and concepts needed in order to start learning calculus?	E. Trigonometric Functions	E1. To convert between radians and degress, and find arc length	Period	2.11.A2.B-Analyze and interpret rates of growth/decay. 2.8.A2.B-Evaluate and simplify algebraic expressions; solve and graph, quadratic, exponential, and logarithmic equations; and, solve and graph systems of equations and inequalities.
			Periodic functions	

			E2. To identify the periodicity and even-odd properties of the trig functions.	Trig functions				2.8.A2.D-Demonstrate an understanding and apply properties of functions (domain, range, inverses) and characteristics of families of functions (linear, polynomial, rational, exponential, logarithmic).
				Inverse Trig Functions				
			E3. To generate the graphs of the trig functions and explore various transformations upon these graphs.					
			E4. To use the inverse trig functions to solve problems.					
O	October - Unit 2							
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	Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
t	What is a limit? What are one sided and two sided limts?	A. Rates of Change and Limits	A1. To calculate average and instantaneous speeds.	Average speed				1.A.1-Limits of functions (including one-sided limits)- An intuitive understanding of the limiting process
o				Instantaneous Speed				1.A.3-Estimating limits from graphs or tables of data
b			A2. To define and calculate limits for function values and apply the properties of limits.	Limit				
e				Properties of Limits				
r			A3. To use the Sandwich Theorem to find certain limits.	One Sided Limit				
				Two sided limit				
				The Sandwich Theorem				
	What are limits involving infinity and how are they found?	B. Limits Involving Infinity	B1. To find and verifty end behavior models for various functions.	horizontal and verticle asymptotes				1.A.1-Limits of functions (including one-sided limits)- An intuitive understanding of the limiting process
				End behavior models				1.B.1-Asymptotic and unbounded behavior- Understanding asymptotes in terms of graphical behavior
			B2. To calculate limits as x approaches infinity and to identify vertical and horizontal asymptotes.					

	What does it mean for a function to be continuous?	C Continuity	C1. To identify the intervals upon which a given function is continuous. C2. To remove removable discontinuities by extending or modifying a function. C3. To apply the Intermediate Value Theorem and the properties of algebraic combinations and composite of continuous functions.	Continuity Removable discontinuity Jump discontinuity infinite discontinuity Oscillating discontinuity Continuous Function				1.C.1-Continuity as a property of functions-An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.) 1.C.2-Understanding continuity in terms of limits
	What is a tangent to a curve and a normal to a curve?	D. Rates of change and tangent lines	D1. To apply directly the definition of the slope of a curve in order to calculate slopes. D2. To find the equations of the tangent line and normal line to a curve at a given point. D3. To find the average rate of change of a function.	average rate of change Tangent to a curve Slope of a curve at a point Normal line				1.B.3-Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)
N	November - Unit 3 : Derivatives (Part 1)							
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	Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
v	What is a derivative?	A. Derivative of a function	A1. To calculate slopes and derivatives using the definition of the derivative	Derivative				2.A.1-Concept of the derivative-Derivative presented graphically, numerically, and analytically

e			To graph f from the graph of f prime; graph f prime from the graph of f; graph the derivative of a function given numerically with data.	Differentiable	2.A.2-Derivative interpreted as an instantaneous rate of change
m				One sided derivatives	2.A.3-Derivative defined as the limit of the difference quotient
b	What does it mean for a function to be differentiable?	B. Differentiability	B1. To find where a function is not differentiable and distinguish between corners, cusps, discontinuities, and vertical tangents.	Differentiability	2.A.4-Relationship between differentiability and continuity
e r			B2. To approximate derivatives numerically and graphically.	corner cusp vertical tangent Discontinuity Intermediate Value Theorem for Derivatives	
	How are derivatives calculated?	C. Rules for Differentiation	C1. To use the rules of differentiation to calculate derivatives, including second and higher order derivatives.	Rules for differentiation Power Rule Constant Multiple Rule Sum and Difference Rule Product Rule Quotient Rule	2.A.2-Derivative interpreted as an instantaneous rate of change 2.A.3-Derivative defined as the limit of the difference quotient 2.F.2-Basic rules for the derivative of sums, products, and quotients of functions
	What is velocity and how is it connected to the derivative?	D. Velocity and Other Rates of Change	D1. To use the rules of differentiation to calculate derivatives, including second and higher order derivatives.	Instantaneous rate of change Velocity Speed Acceleration Marginal cost Marginal revenue	2.E.5-Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration

D December - Unit 3: Derivatives (Part 2)

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Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
c What are the derivatives of the trigonometric functions?	E. Derivatives of Trigonometric Functions	E1. To use the rules for differentiating the six basic trig functions.	Derivatives of trigonometric functions Jerk				2.F.1-Computation of derivatives- Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonomic functions
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m How can you determine the derivative of a composition of functions?	F. Chain Rule	F1. To differentiate composite functions using the Chain Rule	The Chain Rule				2.F.3-Chain rule and implicit differentiation

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J January - Unit 3: Derivatives (Part 3)

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Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
n What are implicitly defined functions and u how are they differentiated?	G. Implicit Differentiation	G1. To find derivatives using implicit differentiation	Implicit Differentiation Derivatives of higher order				2.F.3-Chain rule and implicit differentiation
a		G2. To find derivatives using the Power Rule for Rational Powers of X.					
r							
y How are derivatives of inverse trig functions calculated?	H. Derivatives of Inverse Trig Functions	H1. To calculate derivatives of functions involving the inverse trig functions.	Inverse Functions Derivatives of inverse functions				2.F.1-Computation of derivatives- Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonomic functions
How are the derivatives of exponential and logarithmic functions calculated?	I. Derivatives of Exponential and Logarithmic Functions	I1. To calculate derivatives of exponential and logarithmic functions.	Derivatives of exponential and logarithmic functions				2.F.1-Computation of derivatives- Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonomic functions

F February - Unit 4: Applications of Derivatives(Pa

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Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
b What are extreme values of a function and	A. Extreme Values of	A1. To determine the local or global extreme values of a function.	Absolute extreme values				2.E.2-Optimization, both absolute (global) and relative (local) extreme
r how are they found?	Functions		The Extreme Value Theorem				
u			Local extreme values				
a			Critical Point				
r What is the mean value theorem and how is it applied?	B. Mean Value Theorem	B1. To apply the Mean Value Theorem and to find the intervals on which a function is increasing or	The Mean Value Theorem for Derivatives				2.C.3-The Mean Value Thereon and its geometric consequences
y		decreasing.	Increasing/Decreasing Functions				2.C.2-Relationship between the increasing and decreasing behavior of f and the sign of f'
			Antiderivative				
How can you determine where a function is increasing/decreasing, concave up/down?	C. Connecting f' and f'' with the graph of f.	C1. To use the First and Second Derivative Test to determine the local extreme values of a function.	Concavity				2.C.2-Relationship between the increasing and decreasing behavior of f and the sign of f'
			Point of Inflection				2.D.1-Second derivatives- Corresponding characteristics of the graphs of f, f', and''
		C2. To determine the concavity of a function and locate the points of inflection by analyzing the second derivative.					2.D.2-Relationship between the concavity of the f and the sign of f''
		C3. To graph f using information about f'					2.D.3-Points of inflection as places where concavity changes

M March - Unit 4: Applications of Derivatives (Part

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Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
r What is an application of the derivative?	D. Modeling and Optimization	D1. To solve application problems involving finding minimum or maximum values of functions.	Optimize/ Optimization				2.E.1-Applications of derivatives- Analysis of curves, including the notions of monotonicity and concavity
c							2.E.2-Optimization, both absolute (global) and relative (local) extreme

h	What are ways to approximate change?	E. Linearization and Newton's Method	E1. To find linearizations and use Newton's method to approximate the zeros of a function.	Linearization				2.B.4-Approximate rate of change from graphs and tables of values
				Newton's Method				
			E2. To estimate the change in a function using differentials.	Differentials				
	What are related rates and how are related rates problems solved?	F. Related Rates	F1. To solve related rate problems.	Related Rates				2.E.3-Modeling rates of change, including related rates problems
A	April - Unit 5: The Definite Integral (Part 1)							
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	Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
r	How can the area under a curve be found?	A. Estimating with Finite Sums	A1. To approximate the area under the graph of a nonnegative continuous function by using rectangle approximation methods.	Rectangular approximation Method (RAM)				2.11.A2.C-Estimate areas under curves using sums of areas.
i				Right, Left, and Middle Rectangular Approximationg Method (RRAM, MRAM, LRAM)				
l			A2. To interpret the area under a graph as a net accumulation of a rate of change					
	How can the area under a cuve be expressed as a definite integral and as a limit of Riemann Sums?	B. Definite Integral	B1. To express the area under a curve as a definite integral and as a limit of Riemann Sums.	Riemann Sums				2.11.A2.C-Estimate areas under curves using sums of areas.
				Partition/ subinterval				3.A.1-Interpretation and properties of definite integrals-Definite integral as a limit of Riemann sums
			B2. To compute the area under a curve using a numerical integration procedure.	Integral				

			Lower/Upper limit of integration Area under a curve (as a definite integral)				

M May - Unit 5 : The Definite Integral (Part 2)

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Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards
y How can an integral be evaluated?	C. Definite Integrals and Anitderivatives	C1. To apply rules for definite integrals and find the average value of a function over a closed interval.	Definite integral Average value of a function Antiderivative Mean Value Theorem for Definite Integrals				3.D.1-Techniques of antidifferentiation-Antiderivatives following directly from derivatives of basic functions
What is the Fundamental Theorem of Calculus and how is it applied?	D. Fundamental Theorem of Calculus	D1. To apply the Fundamental Theorem of Calculus.	Fundamental Theorem of Calculus Part 1 and Part 2				3.C.1-Fundamental Theorem of Calculus-Use of the Fundamental Theorem to evaluate definite integrals
		D2. To understand the relationshiop between the derivative and the definite integral as expressed in boths parts of the Fundamental Theorem of Calculus.	Average Daily Inventory				3.C.2-Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined
			Total area				3.D.1-Techniques of antidifferentiation-Antiderivatives following directly from derivatives of basic functions

J June - Unit 6: Differential Equations and Mathema

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Essential Questions	Content	Knowledge and Skills	Vocabulary	Assessments	Lessons	Resources	Standards

n e	What is integration by substitution, when is it used, and how is it applied?	A. Antiderivatives B. Integration by Substitution	A1. To construct antiderivatives using the Fundamental Theorem of Calculus. A2. To solve initial value problems of the form dy/dx=f(x), y"sub 0"=f(x"sub 0") B1. To compute indefinite and definite integrals by the method of substitution	Antiderivatives Definite integral Integration by Substitution	3.D.2-Antiderivatives by substitution of variables (including change of limits for definite integrals)