

## Secondary Mathematics Calculus

Unit 1: Limits and Their Properties		1 <sup>st</sup> 6 Weeks			
Date Taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>Analysis of graphs</b> With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.</p> <p><b>Limits of functions (including one-sided limits)</b></p> <ul style="list-style-type: none"> <li>❖ An intuitive understanding of the limiting process</li> <li>❖ Calculating limits using algebra</li> <li>❖ Estimating Limits from graphs or tables of data</li> </ul> <p><b>Asymptotic and unbounded behavior</b></p> <ul style="list-style-type: none"> <li>❖ Understanding asymptotes in terms of graphical behavior</li> <li>❖ Describing asymptotic behavior in terms of limits involving infinity</li> <li>❖ Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)</li> </ul>	<p>Students will be able to understand what calculus is and how it compares to pre-calculus and that calculus was discovered in order to solve the tangent line and the area problem.</p> <p>Students will learn different ways that a limit can fail to exist and will be able to estimate a limit both numerically &amp; graphically.</p> <p>Students will be able to develop and use different strategies for finding limits.</p> <p>Students will be able to understand continuity and how it applies to the Intermediate Value Theorem as well as determining one-sided limits.</p> <p>Students will be able to determine infinite limits and how it relates to vertical asymptotes.</p>	<p>What is Calculus?</p> <p>How do you estimate a limit both numerically and graphically? When does a limit fail to exist?</p> <p>What strategy should be used to find a limit?</p> <p>When can the Intermediate Value Theorem be applied? When is a function continuous?</p> <p>How do you determine the behavior of a function as it approaches a vertical asymptote from both the left and right sides?</p>	<p>1.1 A Preview of Calculus</p> <p>1.2 Finding Limits Graphically &amp; Numerically</p> <p>1.3 Evaluating Limits Analytically</p> <p>1.4 Continuity &amp; One-Sided Limits</p> <p>1.5 Infinite Limits</p>	<p><b>District Resources</b> Larson <a href="#">Calculus</a> Graphing Calculators HM mathSpace Student CD-ROM Instructional DVDs and Videotapes Complete Solutions Guide Instructor's Resource Manual Fast Track to a 5 HM ClassPrep with HM Testing CD-ROM</p> <p><b>Internet Resources</b> <a href="#">MISD Mathematics Web Site</a> <a href="#">AP Central</a> <a href="#">EduSpace</a> <a href="#">CalcChat</a> <a href="#">Larson Calculus</a></p> <p><b>Manipulatives</b> Mobius Strip CBR's</p> <p><b>Campus Resources</b> To be filled in by each campus</p>



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Unit 1: Limits and Their Properties			1 <sup>st</sup> 6 Weeks		
Date Taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>Continuity as a property of functions</b></p> <ul style="list-style-type: none"> <li>❖ An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.)</li> <li>❖ Understanding continuity in terms of limits</li> <li>❖ Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and the Extreme Value Theorem)</li> </ul>	limit one-sided limit oscillating behavior unbounded behavior secant line tangent line average rate of change instantaneous rate of change continuity points of discontinuity jump discontinuity removable discontinuity nonremovable discontinuity Intermediate Value Theorem			

## Secondary Mathematics Calculus

Unit 2: Differentiation		1 <sup>st</sup> and 2 <sup>nd</sup> 6 Weeks			
Date Taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>Concept of the Derivative</b></p> <ul style="list-style-type: none"> <li>❖ Derivative presented graphically, numerically &amp; analytically</li> <li>❖ Derivative interpreted as an instantaneous rate of change</li> <li>❖ Derivative defined as the limit of the difference quotient</li> <li>❖ Relationship between differentiability and continuity</li> </ul> <p><b>Derivative at a point</b></p> <ul style="list-style-type: none"> <li>❖ 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.</li> <li>❖ Tangent line to a curve at a point and local linear approximation</li> <li>❖ Instantaneous rate of change as a limit of average rate of change</li> <li>❖ Approximate rate of change from graphs and tables of values</li> </ul> <p><b>Application of derivatives</b></p> <ul style="list-style-type: none"> <li>❖ Modeling rates of change, including related rates problems</li> <li>❖ Interpretation of the derivative as a rate of change in varied applied contexts, including, velocity, acceleration and speed</li> <li>❖ Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.</li> </ul>	<p>Students will be able to find the slope of a tangent line to a curve at a point using the limit definition of a derivative.</p> <p>Students will be able to find the derivative of a function using basic differentiation rules and use derivatives to find rates of change.</p> <p>Students will be able to find the derivative of a function using the product and quotient rules. Students will be able to find the derivative of trigonometric functions and higher order derivatives.</p> <p>Students will be able to find derivatives using the chain rule.</p> <p>Students will be able to distinguish between implicit and explicit forms and be able to perform implicit differentiation.</p> <p>Students will be able to use related rates to solve real life application problems.</p>	<p>From where does the limit definition come?</p> <p>How do you find derivatives using basic differentiation rules?</p> <p>How do you find higher order derivatives using basic differentiation rules?</p> <p>When do you use the product and quotient rules?</p> <p>How do you recognize and find the derivative of a composition function?</p> <p>What is an implicit function and how do you differentiate it?</p> <p>What method do you use to solve related rate problems in the real world?</p>	<p>2.1 The Derivative and the Tangent Line Problem</p> <p>2.2 Basic Differentiation Rules and Rates of Change</p> <p>2.3 Product and Quotient Rules and Higher Order Derivatives</p> <p>2.4 The Chain Rule</p> <p>2.5 Implicit Differentiation</p> <p>2.6 Related Rates</p>	<p><b>District Resources</b> Larson <a href="#">Calculus</a> Graphing Calculators HM mathSpace Student CD-ROM Instructional DVDs and Videotapes Complete Solutions Guide Instructor's Resource Manual Fast Track to a 5 HM ClassPrep with HM Testing CD-ROM</p> <p><b>Internet Resources</b> <a href="#">MISD Mathematics Web Site</a> <a href="#">AP Central</a> <a href="#">EduSpace</a> <a href="#">CalcChat</a> <a href="#">Larson Calculus</a></p> <p><b>Manipulatives</b> Balloons, Funnels, and "Little Ladders" (6-inch Rulers)</p> <p><b>Campus Resources</b> To be filled in by each campus</p>



## Secondary Mathematics Calculus

Unit 2: Differentiation			1 <sup>st</sup> 6 Weeks		
Date Taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<b>Computation of Derivatives</b> <ul style="list-style-type: none"> <li>❖ Basic rules for the derivative of sums, products and quotients of functions</li> <li>❖ Chain Rule and Implicit Differentiation</li> </ul>	tangent line secant line difference quotient derivative differentiate higher order derivative chain rule implicit function explicit function implicit differentiation related rate			

## Secondary Mathematics Calculus

Unit 3: Applications of Differentiation		3 <sup>rd</sup> and 4 <sup>th</sup> 6 Weeks			
Date taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>DERIVATIVES</b></p> <p><b>Derivatives as a Function</b></p> <ul style="list-style-type: none"> <li>❖ Corresponding characteristics of graphs of <math>f</math> and <math>f'</math></li> <li>❖ Relationship between the increasing and decreasing behavior of <math>f</math> and the sign of <math>f'</math></li> <li>❖ The Mean Value Theorem and its geometric consequences</li> <li>❖ Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.</li> </ul> <p><b>Second Derivatives</b></p> <ul style="list-style-type: none"> <li>❖ Corresponding characteristics of the graphs of <math>f</math>, <math>f'</math>, and <math>f''</math></li> <li>❖ Relationship between the concavity of <math>f</math> and the sign of <math>f''</math></li> <li>❖ Points of inflection as places where concavity changes</li> </ul> <p><b>Applications of Derivatives</b></p> <ul style="list-style-type: none"> <li>❖ Analysis of curves including the notions of monotonicity and concavity</li> <li>❖ Optimization, both absolute (global) and relative (local) extrema</li> </ul>	<p>Students will be able to understand the definition of absolute and relative extrema and be able to find them on both open and closed intervals.</p> <p>Students will be able to understand and use Rolle's Theorem and the Mean Value Theorem.</p> <p>Students will be able to determine intervals on which a function is increasing or decreasing and apply the First Derivative Test to find relative extrema.</p> <p>Students will be able to determine intervals on which a function is concave upward or concave downward and be able to find points of inflection and be able to apply the Second Derivative Test to find relative extrema.</p> <p>Students will be able to determine limits at infinity and how that relates to horizontal asymptotes.</p> <p>Students will be able to analyze and sketch a graph of a function.</p>	<p>What are extrema and how can you find them on a closed interval?</p> <p>What are Rolle's Theorem and the Mean Value Theorem and when do they apply?</p> <p>How can you tell when a function is increasing or decreasing?</p> <p>How can you use the First Derivative Test to find relative extrema.</p> <p>How do you determine concavity and points of inflection?</p> <p>What are the similarities and differences between the First and Second Derivative Tests?</p> <p>How do you find the end behavior of a function?</p> <p>How can you analyze and sketch a graph of a function without test points?</p>	<p>3.1 Extrema on an interval</p> <p>3.2 Rolle's Theorem and the Mean Value Theorem</p> <p>3.3 Increasing &amp; Decreasing Functions and the First Derivative Test</p> <p>3.4 Concavity and the Second Derivative Test</p> <p>3.5 Limits at Infinity</p> <p>3.6 A Summary of Curve Sketching</p>	<p><b>District Resources</b></p> <p>Larson <a href="#">Calculus</a></p> <p>Graphing Calculators</p> <p>HM mathSpace Student CD-ROM</p> <p>Instructional DVDs and Videotapes</p> <p>Complete Solutions Guide</p> <p>Instructor's Resource Manual</p> <p>Fast Track to a 5</p> <p>HM ClassPrep with HM Testing CD-ROM</p> <p><b>Internet Resources</b></p> <p><a href="#">MISD Mathematics Web Site</a></p> <p><a href="#">AP Central</a></p> <p><a href="#">EduSpace</a></p> <p><a href="#">CalcChat</a></p> <p><a href="#">Larson Calculus</a></p> <p><b>Manipulatives</b></p> <p>Cardboard, Scissors, and Wire</p> <p><b>Campus Resources</b></p> <p>To be filled in by each campus</p>

## Secondary Mathematics Calculus

Unit 3: Applications of Differentiation			4 <sup>th</sup> 6 Weeks		
Date taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>DERIVATIVES</b></p> <p><b>Derivatives as a Function</b></p> <ul style="list-style-type: none"> <li>❖ Corresponding characteristics of graphs of <math>f</math> and <math>f'</math></li> <li>❖ Relationship between the increasing and decreasing behavior of <math>f</math> and the sign of <math>f'</math></li> <li>❖ The Mean Value Theorem and its geometric consequences</li> <li>❖ Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.</li> </ul> <p><b>Second Derivatives</b></p> <ul style="list-style-type: none"> <li>❖ Corresponding characteristics of the graphs of <math>f</math>, <math>f'</math>, and <math>f''</math></li> <li>❖ Relationship between the concavity of <math>f</math> and the sign of <math>f''</math></li> <li>❖ Points of inflection as places where concavity changes</li> </ul> <p><b>Applications of Derivatives</b></p> <ul style="list-style-type: none"> <li>❖ Analysis of curves including the notions of monotonicity and concavity</li> <li>❖ Optimization, both absolute (global) and relative (local) extrema</li> </ul>	<p>Students will be able to solve applied minimum and maximum problems.</p> <p>Students will be able to approximate function zeros using Newton's Method.</p> <p>Students will be able to understand the concept to a tangent line approximation.</p> <p>relative (local) extrema absolute (global) extrema critical numbers Rolle's Theorem Mean Value Theorem Extreme Value Theorem Monotonic First Derivative Test Second Derivative Test Concavity Points of Inflection Optimization Newton's Method Linear Approximation Differential</p>	<p>How can calculus be used to solve optimization application problems?</p> <p>What is Newton's Method?</p> <p>What is a differential and how does it compare to the value of the actual change in <math>y</math>?</p>	<p>3.7 Optimization Problems</p> <p>3.8 Newton's Method</p> <p>3.9 Differentials</p>	

## Secondary Mathematics Calculus

Unit 4: Integration		4 <sup>th</sup> and 5 <sup>th</sup> 6 Weeks			
Date taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>Integrals</b></p> <p><b>Interpretations and Numerical Approximations</b></p> <ul style="list-style-type: none"> <li>Definite integral as a limit of Riemann Sums</li> <li>Use of Riemann Sums (using left, right, and midpoint evaluation points) to approximate definite integrals of functions represented algebraically, graphically and by table of values</li> </ul> <p><b>Applications of integrals</b> Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann Sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include using the integral of a rate of change to give accumulated change, finding the area of a region, the average value of a function, and the distance traveled by a particle along a line.</p> <p><b>Properties of Definite Integrals</b></p> <ul style="list-style-type: none"> <li>Definite Integrals of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval</li> <li>Basic properties of definite integrals (examples include additivity and linearity)</li> </ul>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>Write the general solution for a differential equation</li> <li>Use indefinite integral notation for antiderivatives</li> <li>Use basic integration rules to find antiderivatives</li> <li>Find a particular solution of a differential equation</li> </ul> <p>Students will be able to use sigma notation to write and evaluate a sum and understand the concept of area and be to approximate the area of a plane region.</p> <p>Students will be able to understand the definition of a Riemann sum. Students will be able to evaluate a definite integral using properties of definite integrals.</p>	<p>How do you find a particular solution of a differential equation?</p> <p>How can you find the area of a plane region?</p> <p>How can sigma notation be utilized to find areas? What is a Riemann Sum and what is its purpose? How can you evaluate a definite integral using properties of definite integrals?</p> <p>What are the Fundamental Theorems of Calculus? How can you find the average value of a function? What is the Mean Value Theorem for integrals?</p>	<p>4.1 Antiderivatives and Indefinite Integration</p> <p>4.2 Area</p> <p>4.3 Riemann Sums and Definite Integrals</p> <p>4.4 The Fundamental Theorem of Calculus</p>	<p><b>District Resources</b></p> <p>Larson <a href="#">Calculus</a></p> <p>Graphing Calculators</p> <p>HM mathSpace Student CD-ROM</p> <p>Instructional DVDs and Videotapes</p> <p>Complete Solutions Guide</p> <p>Instructor's Resource Manual</p> <p>Fast Track to a 5</p> <p>HM ClassPrep with HM Testing CD-ROM</p> <p><b>Internet Resources</b></p> <p><a href="#">MISD Mathematics Web Site</a></p> <p><a href="#">AP Central</a></p> <p><a href="#">EduSpace</a></p> <p><a href="#">CalcChat</a></p> <p><a href="#">Larson Calculus</a></p> <p><b>Manipulatives</b></p> <p><b>Campus Resources</b></p> <p>To be filled in by each campus</p>



## Secondary Mathematics Calculus

Unit 4: Integration			4 <sup>th</sup> and 5 <sup>th</sup> 6 Weeks		
Date taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p>Students will be able to use sigma notation to write and evaluate a sum and understand the concept of area and be to approximate the area of a plane region.</p> <p>Students will be able to understand the definition of a Riemann sum.</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> <li>• Write the general solution for a differential equation</li> <li>• Use indefinite integral notation for antiderivatives</li> <li>• Use basic integration rules to find antiderivatives</li> <li>• Find a particular solution of a differential equation</li> </ul> <p>Students will be able to evaluate a definite integral using properties of definite integrals.</p> <p><b>Fundamental Theorem of Calculus</b></p> <ul style="list-style-type: none"> <li>• Use of the Fundamental Theorem to evaluate definite integrals</li> <li>• Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined</li> </ul>	<p>Students will be able to understand and use the First and Second Fundamental Theorems of Calculus and the Mean Value Theorem for Integrals and be able to find the average value of a function over a closed interval.</p> <p>Sigma Notation Riemann Sum Upper &amp; Lower Sums Inscribed Rectangles Circumscribed Rectangles Midpoint Rule Accumulation Function Antiderivative Indefinite Integral Definite Integral General Solution Particular Solution Initial Condition Fundamental Theorem of Calculus Second Fundamental Theorem of Calculus Mean Value Theorem of Integrals Average Value of Function Trapezoidal Rule Change of Variable</p>			

## Secondary Mathematics Calculus

Unit 4: Integration			3 <sup>rd</sup> 6 Weeks		
Date taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>Techniques of Antidifferentiation</b></p> <ul style="list-style-type: none"> <li>❖ Antiderivatives following directly from the derivatives of basic functions</li> <li>❖ Antiderivatives by substitution of variables (including change of limits for definite integrals)</li> <li>❖ Finding specific antiderivatives using initial conditions, including applications to motion along a line</li> </ul>	<p>Students will be able to use a variety of techniques to solve definite and indefinite integrals.</p> <p>Students will be able to approximate a definite integral by using the Trapezoidal Rule.</p> <p>Sigma Notation Riemann Sum Upper &amp; Lower Sums Inscribed Rectangles Circumscribed Rectangles Midpoint Rule Accumulation Function Antiderivative Indefinite Integral Definite Integral General Solution Particular Solution Initial Condition Fundamental Theorem of Calculus Second Fundamental Theorem of Calculus Mean Value Theorem of Integrals Average Value of Function Trapezoidal Rule Change of Variable</p>	<p>How can I solve more advanced integration?</p> <p>What is the Trapezoidal Rule?</p>	<p>4.5 Integration by Substitution</p> <p>4.6 Numerical Integration</p>	<p><b>District Resources</b> Larson <a href="#">Calculus</a> Graphing Calculators HM mathSpace Student CD-ROM Instructional DVDs and Videotapes Complete Solutions Guide Instructor's Resource Manual Fast Track to a 5 HM ClassPrep with HM Testing CD-ROM</p> <p><b>Internet Resources</b> <a href="#">MISD Mathematics Web Site</a> <a href="#">AP Central</a> <a href="#">EduSpace</a> <a href="#">CalcChat</a> <a href="#">Larson Calculus</a></p> <p><b>Manipulatives</b></p> <p><b>Campus Resources</b> To be filled in by each campus</p>



## Secondary Mathematics Calculus

Unit 5: Logarithmic, Exponential, & Other Transcendental Functions			6 <sup>th</sup> 6 Weeks		
Date Taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>Transcendental Functions</b></p> <p><b>Derivatives</b> Knowledge of derivatives of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions</p> <p><b>Antiderivatives</b> Knowledge of integration of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions</p>	<p>Students will be able to find derivatives of functions involving the natural logarithmic function.</p> <p>Students will be able to integrate trigonometric functions and use the log rule for integration to integrate rational functions.</p> <p>Students will be able to find the derivative of an inverse function?</p> <p>Students will be able to differentiate and integrate natural exponential functions.</p> <p>Students will be able to differentiate and integrate exponential functions that have bases other than <math>e</math> and be able to model compound interest and exponential growth.</p>	<p>What is the definition of the number <math>e</math>? What are the properties of natural log?</p> <p>How do you integrate logarithmic and trigonometric functions?</p> <p>What is an inverse function and how is it related to the original function?</p> <p>What are natural exponential functions and how are they utilized in calculus?</p> <p>How can you model compound interest and exponential growth and decay?</p>	<p>5.1 The Natural Logarithmic Function: Differentiation</p> <p>5.2 The Natural Logarithmic Function: Integration</p> <p>5.3 Inverse Functions</p> <p>5.4 Exponential Functions: Differentiation and Integration</p> <p>5.5 Bases other than <math>e</math> and Applications</p>	<p><b>District Resources</b> Larson <a href="#">Calculus</a> Graphing Calculators HM mathSpace Student CD-ROM Instructional DVDs and Videotapes Complete Solutions Guide Instructor's Resource Manual Fast Track to a 5 HM ClassPrep with HM Testing CD-ROM</p> <p><b>Internet Resources</b> <a href="#">MISD Mathematics Web Site</a> <a href="#">AP Central</a> <a href="#">EduSpace</a> <a href="#">CalcChat</a> <a href="#">Larson Calculus</a></p> <p><b>Manipulatives</b></p> <p><b>Campus Resources</b> To be filled in by each campus</p>



## Secondary Mathematics Calculus

Unit 5: Logarithmic, Exponential, & Other Transcendental Functions		3 <sup>rd</sup> 6 Weeks			
Date Taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
	<p><b>Transcendental Functions</b></p> <p><b>Derivatives</b> Knowledge of derivatives of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions</p> <p><b>Antiderivatives</b> Knowledge of integration of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions</p>	<p>Students will be able to differentiate an inverse trigonometric function.</p> <p>One-to-One Function Inverse Trigonometric Functions</p>	<p>How can you differentiate trigonometric and inverse trigonometric functions?</p>	<p>5.6 Inverse Trigonometric Functions: Differentiation</p>	