Mathematics
Advanced Placement Calculus BC

Unit 1: Limits and Their Properties			1st 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Analysis of graphs 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. **Limits of functions (including one-sided limits)** ❖ An intuitive understanding of the limiting process ❖ Calculating limits using algebra ❖ Estimating Limits from graphs or tables of data **Asymptotic and unbounded behavior** ❖ Understanding asymptotes in terms of graphical behavior ❖ Describing asymptotic behavior in terms of limits involving infinity ❖ Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)	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. Students will learn different ways that a limit can fail to exist and will be able to estimate a limit both numerically & graphically. Students will be able to develop and use different strategies for finding limits. Students will be able to understand continuity and how it applies to the Intermediate Value Theorem as well as determining one-sided limits. Students will be able to determine infinite limits and how it relates to vertical asymptotes. Students will be able to determine limits at infinity and how that relates to horizontal asymptotes.	What is Calculus? How do you estimate a limit both numerically and graphically? When does a limit fail to exist? What strategy should be used to find a limit? When can the Intermediate Value Theorem be applied? When is a function continuous? How do you determine the behavior of a function as it approaches a vertical asymptote from both the left and right sides? How do you find the end behavior of a function?	1.1 A Preview of Calculus 1.2 Finding Limits Graphically & Numerically 1.3 Evaluating Limits Analytically 1.4 Continuity & One-Sided Limits 1.5 Infinite Limits 3.5 Limits at Infinity	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** Mobius Strip CBR's **Campus Resources** To be filled in by each campus

Unit 1: Limits and Their Properties			1st 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	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.) ❖ Understanding continuity in terms of limits ❖ Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and the Extreme Value Theorem)	**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**			

Unit 2: Differentiation			1st 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Concept of the Derivative ❖ Derivative presented graphically, numerically & analytically ❖ Derivative interpreted as an instantaneous rate of change ❖ Derivative defined as the limit of the difference quotient ❖ Relationship between differentiability and continuity **Derivative at a point** ❖ 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. ❖ Tangent line to a curve at a point and local linear approximation ❖ Instantaneous rate of change as a limit of average rate of change ❖ Approximate rate of change from graphs and tables of values **Application of derivatives** ❖ Modeling rates of change, including related rates problems ❖ Interpretation of the derivative as a rate of change in varied applied contexts, including, velocity, acceleration and speed ❖ Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.	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. Students will be able to find the derivative of a function using basic differentiation rules and use derivatives to find rates of change. 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. Students will be able to find derivatives using the chain rule. Students will be able to distinguish between implicit and explicit forms and be able to perform implicit differentiation. Students will be able to use related rates to solve real life application problems.	From where does the limit definition come? How do you find derivatives using basic differentiation rules? How do you find higher order derivatives using basic differentiation rules? When do you use the product and quotient rules? How do you recognize and find the derivative of a composition function? What is an implicit function and how do you differentiate it? What method do you use to solve related rate problems in the real world?	2.1 The Derivative and the Tangent Line Problem 2.2 Basic Differentiation Rules and Rates of Change 2.3 Product and Quotient Rules and Higher Order Derivatives 2.4 The Chain Rule 2.5 Implicit Differentiation 2.6 Related Rates	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** Balloons, Funnels, and "Little Ladders" (6-inch Rulers) **Campus Resources** To be filled in by each campus

Unit 2: Differentiation			1st 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Computation of Derivatives ❖ Basic rules for the derivative of sums, products and quotients of functions ❖ Chain Rule and Implicit Differentiation	**tangent line** **secant line** **difference quotient** **derivative** **differentiate** **higher order derivative** **chain rule** **implicit function** **explicit function** **implicit differentiation** **related rate**			

Unit 3: Applications of Differentiation			**1st 6 Weeks**		
Date taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	DERIVATIVES **Derivatives as a Function** ❖ Corresponding characteristics of graphs of *f* and *f'* ❖ Relationship between the increasing and decreasing behavior of *f* and the sign of *f'* ❖ The Mean Value Theorem and its geometric consequences ❖ Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa. **Second Derivatives** ❖ Corresponding characteristics of the graphs of *f*, *f'*, and *f''* ❖ Relationship between the concavity of *f* and the sign of *f''* ❖ Points of inflection as places where concavity changes **Applications of Derivatives** ❖ Analysis of curves including the notions of monotonicity and concavity ❖ Optimization, both absolute (global) and relative (local) extrema	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. Students will be able to understand and use Rolle's Theorem and the Mean Value Theorem. 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. 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. Students will be able to analyze and sketch a graph of a function.	What are extrema and how can you find them on a closed interval? What are Rolle's Theorem and the Mean Value Theorem and when do they apply? How can you tell when a function is increasing or decreasing? How can you use the First Derivative Test to find relative extrema. How do you determine concavity and points of inflection? What are the similarities and differences between the First and Second Derivative Tests? How can you analyze and sketch a graph of a function without test points?	3.1 Extrema on an interval 3.2 Rolle's Theorem and the Mean Value Theorem 3.3 Increasing & Decreasing Functions and the First Derivative Test 3.4 Concavity and the Second Derivative Test 3.6 A Summary of Curve Sketching	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** Cardboard, Scissors, and Wire **Campus Resources** To be filled in by each campus

Unit 3: Applications of Differentiation			1st 6 Weeks		
Date taught	AP Required Elements	Content/Vocabulary	Guiding Questions	Activities	Resources
		Students will be able to solve applied minimum and maximum problems. **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**	How can calculus be used to solve optimization application problems?	3.7 Optimization Problems	

Unit 3: Applications of Differentiation			2nd 6 Weeks		
Date taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	DERIVATIVES **Derivatives as a Function** ❖ Corresponding characteristics of graphs of *f* and *f'* ❖ Relationship between the increasing and decreasing behavior of *f* and the sign of *f'* ❖ The Mean Value Theorem and its geometric consequences ❖ Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa. **Second Derivatives** ❖ Corresponding characteristics of the graphs of *f*, *f'*, and *f''* ❖ Relationship between the concavity of *f* and the sign of *f''* ❖ Points of inflection as places where concavity changes **Applications of Derivatives** ❖ Analysis of curves including the notions of monotonicity and concavity ❖ Optimization, both absolute (global) and relative (local) extrema	Students will be able to solve applied minimum and maximum problems. Students will be able to approximate function zeros using Newton's Method. Students will be able to understand the concept to a tangent line approximation. **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**	How can calculus be used to solve optimization application problems? What is Newton's Method? What is a differential and how does it compare to the value of the actual change in *y*?	3.7 Optimization Problems 3.8/3.9 Newton's Method & Differentials	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** Cardboard, Scissors, and Wire **Campus Resources** To be filled in by each campus

Unit 4: Integration (Conceptual)			2nd 6 Weeks		
Date taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Integrals **Interpretations and Numerical Approximations** ❖ Definite integral as a limit of Riemann Sums ❖ 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 **Applications of integrals** 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. **Properties of Definite Integrals** ❖ Definite Integrals of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval ❖ Basic properties of definite integrals (examples include additivity and linearity)	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. Students will be able to understand the definition of a Riemann sum. Students will be able to: ❖ Write the general solution for a differential equation ❖ Use indefinite integral notation for antiderivatives ❖ Use basic integration rules to find antiderivatives ❖ Find a particular solution of a differential equation Students will be able to evaluate a definite integral using properties of definite integrals.	How do you find a particular solution of a differential equation? How can you find the area of a plane region? 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?	4.1 Antiderivatives and Indefinite Integration 4.2 Area 4.3 Riemann Sums 4.3 Definite Integrals	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** To be filled in by each campus

Unit 4: Integration (Conceptual)			2nd 6 Weeks		
Date taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Fundamental Theorem of Calculus ❖ Use of the Fundamental Theorem to evaluate definite integrals ❖ Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined **Techniques of Antidifferentiation** ❖ Antiderivatives following directly from the derivatives of basic functions ❖ Antiderivatives by substitution of variables (including change of limits for definite integrals) ❖ Finding specific antiderivatives using initial conditions, including applications to motion along a line	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. Students will be able to use a variety of techniques to solve definite and indefinite integrals. Students will be able to approximate a definite integral by using the Trapezoidal Rule. **Sigma Notation** **Riemann Sum** **Upper & 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**	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? How can I solve more advanced integration? What is the Trapezoidal Rule?	4.4 The Fundamental Theorem of Calculus 4.5 Integration by Substitution 4.6 Numerical Integration	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** **To be filled in by each campus**

Unit 5: Logarithmic, Exponential, & Other Transcendental Functions			2nd 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Transcendental Functions **Derivatives** Knowledge of derivatives of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions **Antiderivatives** Knowledge of integration of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions	Students will be able to find derivatives of functions involving the natural logarithmic function. Students will be able to integrate trigonometric functions and use the log rule for integration to integrate rational functions. Students will be able to find the derivative of an inverse function? Students will be able to differentiate and integrate natural exponential functions. Students will be able to differentiate and integrate exponential functions that have bases other than *e* and be able to model compound interest and exponential growth.	What is the definition of the number *e*? What are the properties of natural log? How do you integrate logarithmic and trigonometric functions? What is an inverse function and how is it related to the original function? What are natural exponential functions and how are they utilized in calculus? How can you model compound interest and exponential growth and decay?	5.1 The Natural Logarithmic Function: Differentiation 5.2 The Natural Logarithmic Function: Integration 5.3 Inverse Functions 5.4 Exponential Functions: Differentiation and Integration 5.5 Bases other than *e* and Applications	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** To be filled in by each campus

Unit 5: Logarithmic, Exponential, & Other Transcendental Functions			3rd 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Transcendental Functions **Derivatives** Knowledge of derivatives of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions **Antiderivatives** Knowledge of integration of basic functions, exponential, logarithmic, trigonometric, and inverse trigonometric functions	Students will be able to differentiate an inverse trigonometric function. Students will be able to integrate an inverse trigonometric function. **One-to-One Function** **Inverse Trigonometric Functions**	How can you differentiate trigonometric and inverse trigonometric functions? How can you integrate trigonometric and inverse trigonometric functions?	5.6 Inverse Trigonometric Functions: Differentiation 5.7 Inverse Trigonometric Functions: Integration	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** To be filled in by each campus

Unit 6/7: Differential Equations & Applications of Integration			3rd 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Applications of derivatives & integrals ❖ Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations ❖ Solving separable differential equations and using them in modeling (in particular, studying the equation $y' = ky$ and exponential growth) ❖ Numerical solution of differential equations using Euler's Method ❖ Solving logistic differential equations and using them in modeling **Applications of integration** Specific applications should include finding the volume of a solid with known cross sections, the volume of revolutions, and the length of a curve.	Students will be able to use slope fields and Euler's Method to approximate solutions of differential equations. Students will be able to use separation of variables to solve a simple differential equation and will be able to use exponential functions to model growth and decay in applied problems. Students will be able to recognize and solve differential equations that can be solved by separation of variables and use these equations to model and solve applied problems. Students will be able to find the area between two curves (including intersecting curves) by integration. Students will be able to find the volume of a solid of revolution using the disc and washer method and be able to find the volume of a solid with known cross sections.	How are slope fields and Euler's Method used to approximate solutions of differential equations? How can growth and decay applications be modeled by exponential functions? How can you use separation of variables to solve applied differential equation? What is the area of a region between two curves? What is the volume of a solid? What is a cross section?	6.1 Slope Fields and Euler's Method 6.2 Differential Equations: Growth and Decay 6.3 Separation of Variables and the Logistic Equation 7.1 Area of a Region Between Two Curves 7.2 Volume: The Disc Method	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** Gridded Chart Paper, Markers, Modeling Clay, Index Cards, and Washers **Campus Resources** To be filled in by each campus

Unit 6/7: Differential Equations & Applications of Integration			3rd 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
		Students will be able to find the volume of a solid of revolution using the Shell Method and compare the uses of the Disc Method and the Shell Method Students will be able to find the arc length of a smooth curve and find the area of a surface of revolution. Students will review all five AB topics and take an AP-style AB test over a 2-day period. **Slope Fields** **Separation of Variables** **Differential Equations** **Newton's Law of Cooling** **Disk Method** **Washer Method** **Axis of Revolution** **Solid of Revolution** **Cross-Section** **Shell Method** **Surface of Revolution** **Rectifiable** **Continuously Differentiable** **Arc Length** **Smooth Curve**	What is the Shell Method? What are the similarities and differences between the Disc and Shell Methods?	7.3 Volume: The Shell Method 7.4 Arc Length	

Unit 8: Integration Techniques, L'Hôpital's Rule, & Improper Integrals			3rd 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Applications of Derivatives ❖ L'Hôpital's Rule, including its use in determining limits **Techniques of Antidifferentiation** ❖ Antiderivatives following directly from derivatives of basic functions ❖ Antiderivatives by substitution of variables (including change of limits for definite integrals), parts, and simple partial fractions (nonrepeating linear factors only) Improper Integrals (as limits of definite integrals)	Students will be able to review procedures for fitting an integrand to one of the basic integration rules. Students will be able to find an antiderivative using integration by parts. Students will be able to solve trigonometric integrals involving powers of sine, cosine, secant, tangent and sine-cosine products with different angles. Students will be able to understand the concept of a partial fraction decomposition and use it with linear factors to integrate rational functions. **Integration by Parts** **Centroid** **Tabular Method** **Partial Fractions** **Decomposition** **Wallis's Formula** **L'Hôpital's Rule** **Indeterminate Form** **Improper Integrals**	What method should you use to solve basic integrals? How do you use integration by parts to solve an antiderivative? How do you solve integrals with powers of trigonometric functions? What is partial fraction decomposition? How can it be used to integrate rational functions?	8.1 Basic Integration Rules 8.2 Integration by Parts 8.3 Trigonometric Integrals 8.5 Partial Fractions	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** To be filled in by each campus

Unit 8: Integration Techniques, L'Hôpital's Rule, & Improper Integrals			4th 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Applications of Derivatives ❖ L'Hôpital's Rule, including its use in determining limits **Techniques of Antidifferentiation** ❖ Antiderivatives following directly from derivatives of basic functions ❖ Antiderivatives by substitution of variables (including change of limits for definite integrals), parts, and simple partial fractions (nonrepeating linear factors only) Improper Integrals (as limits of definite integrals)	Students will be able to recognize limits that produce indeterminate forms and will be able to apply L'Hôpital's Rule to evaluate a limit. Students will be able to evaluate an improper integral that has an infinite limit of integration and an infinite discontinuity.	When can L'Hôpital's Rule be utilized to evaluate a limit? How can you evaluate an improper integral with an infinite limit of integration or an infinite discontinuity?	8.7 Indeterminate Forms and L'Hôpital's Rule 8.8 Improper Integrals	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** To be filled in by each campus

Unit 9: Infinite Series			4th 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Polynomial Approximations and Series **Concept of series** A series is defined as a sequence of partial sums, and convergence is defined in terms of the limit of the sequence of partial sums. Technology can be used to explore convergence or divergence. **Series of constants** ❖ Motivating examples, including decimal expansion ❖ Geometric series with applications ❖ The harmonic series ❖ Alternating series with error bound ❖ Terms of series as areas of rectangles and their relationship to improper integrals, including the integral test and its use in testing the convergence of *p*-series ❖ The ratio test for convergence and divergence ❖ Comparing series to test for convergence and divergence ❖ L'Hôpital's Rule and how it is used to determine convergence of improper integrals and series **Taylor Series** ❖ Taylor polynomial approximation with graphical demonstration of convergence (for example, viewing graphs of various Taylor polynomials of the sine function approximating the sine curve)	Students will be able to list the terms of a sequence, determine whether it diverges or converges, write a formula for the *n*th term of a sequence, and use properties of monotonic sequences and bounded sequences. Students will be able to understand the definition of a convergent infinite series, use properties of infinite geometric series, and use the nth term test for divergence of an infinite series. Students will be able to use the integral test to determine whether an infinite series converges or diverges and use properties of *p*-series and harmonic series. Students will be able to use the Direct Comparison Test and the Limit Comparison Test to determine whether a series diverges or converges. Students will be able to use the Alternating Series Test to determine whether an infinite series converges, use the Alternating Series Remainder to approximate the sum of an	What determines a sequence and how can you tell if it diverges or converges? How can you recognize a convergent infinite series? How can the integral test be used to determine whether infinite series diverges or converges? What is a harmonic series? What are the Direct Comparison Test and the Limit Comparison Test and what are they used for? What is an alternating series?	9.1 Sequences 9.2 Series and Convergence 9.3 The Integral Test and *p*-series 9.4 Comparison of Series 9.5 Alternating Series	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** To be filled in by each campus

Unit 9: Infinite Series			4th 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	❖ Maclaurin series and the general Taylor series centered at $x = a$ ❖ Maclaurin series for the functions e^x, sin x, cos x, and $1/(1-x)$	alternating series, classify a convergent series as absolutely or conditionally convergent, and rearrange an infinite series to obtain a different sum.			
	❖ Formal manipulation of Taylor series and shortcuts to computing Taylor series, including substitution, differentiation, antidifferentiation, and the formation of new series from known series.	Students will be able to use the Ratio Test and the Root Test to determine whether a series converges or diverges and review the tests for convergence and divergence of an infinite series.	How do you apply the Ratio and Root Tests to determine the convergence of a series?	9.6 The Ratio Test	
	❖ Radius and interval of convergence of power series ❖ Lagrange error bound for Taylor polynomials	Students will be able to find polynomial approximations of elementary functions and compare them with the elementary functions, find Taylor and Maclaurin Polynomial Approximations of elementary functions and use the remainder of a Taylor Polynomial.	What are the Taylor and Maclaurin Polynomials?	9.7 Taylor Polynomials and Approximations	
		Students will be able to find the radius and convergence, determine the endpoint convergence, and differentiate and integrate a power series.	What is a power series?	9.8 Power Series	
		Students will be able to find a geometric power series that represents a function and construct a power series using series operations.	How can you construct a power series?	9.9 Representation of Functions by Power Series	

Unit 9: Infinite Series			4th 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
		Students will be able to find a Taylor or Maclaurin Series for a function, find a binomial series, and use a basic list of Taylor Series to find other Taylor Series. **Converge** **Diverge** **Absolute Value Theorem** **Monotonic Sequence** **Bounded Monotonic Sequences** **Least Upper Bound** **nth Partial Sum** **Telescoping Series** **The Integral Test** ***p*-series** **Harmonic Series** **Direct Comparison Test** **Limit Comparison Test** **Alternating Series** **Conditional Convergence** **Absolute Convergence** **Ratio Test** **Root Test** **Taylor Polynomial and Series** **Maclaurin Polynomial & Series** **Taylor's Theorem** **Power Series** **Radius of Convergence** **Interval of Convergence** **Binomial Series** **Lagrange error bound**	What are the Taylor and Maclaurin Series? How can you find a binomial series?	9.10 Taylor and Maclaurin Series	

Unit 10: Parametric Equations, Polar Coordinates, & Vectors			5th 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	Parametric, polar, and vector functions The analysis of planar curves includes those given in parametric form, polar form, and vector form. **Computation and Applications of Derivatives** ❖ Derivatives of parametric, polar, and vector functions ❖ Analysis of planar curves given in parametric form, polar form, and vector form, including velocity and acceleration **Computation and Applications of Integrals** ❖ Integrate vector functions ❖ Finding the area of the region bounded by polar curves ❖ Length of a curve given in parametric form and polar form ❖ Find the tangent line to a curve written in both parametric and polar forms ❖ Find the area of a surface of revolution given by an equation in parametric form and polar form	Students will be able to graph parametric functions, write parametric equations to represent a curve, and understand the tautochrone and brachistochrone problems. Students will be able to find the slope of a tangent line to a curve, arc length, and area of a surface of revolution given by a set of parametric equations. Students will be able to sketch the graph of an equation given in polar form and find the slope of a tangent line to a polar graph. Students will be able to find the area of a region bounded by a polar graph, points of intersection of two polar graphs, the arc length of a polar graph, and the area of a surface of revolution (polar form). Students will be able to write the component form of a vector, perform vector operations, write a vector as a linear combination of standard unit vectors, and use vectors to solve problems involving force or velocity.	What are the tautochrone and brachistochrone problems? How do you eliminate the parameter? How can we apply what we already know about arc length and area of a surface of revolution to parametric functions? How do you change rectangular coordinates to polar coordinates and vice versa? How can we apply what we already know about area between curves, arc length and area of a surface of revolution to polar graphs? What is a vector and how can they be used in the real world? How do you break down a vector into its components?	10.2 Plane Curves and Parametric Equations 10.3 Parametric Equations & Calculus 10.4 Polar Equations and Polar Graphs 10.5 Area in Polar Coordinates 11.1 Vectors in a Plane	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** Polar coordinate grids **Campus Resources** To be filled in by each campus

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		Students will be able to analyze and sketch a space curve given by a vector-valued function and extend the concepts of limits and continuity to vector-valued functions.	What is a vector-valued function? How do you represent a graph by a vector-valued function?	12.1 Vector-Valued Functions	
		Students will be able to differentiate and integrate a vector-valued function.	What is a vector-valued function? How do we differentiate and integrate them?	12.2 Differentiation and Integration of Vector-Valued Functions	
		Students will be able to use a vector-valued function to analyze projectile motion and describe the velocity and acceleration associated with vector-valued functions. **Parametric Equations** **Parameter** **Tautochrone** **Brachistochrone** **Cycloid** **Piecewise Smooth** **Radial Lines** **Spiral of Archimedes** **Cardioid** **Rose Curves** **Limaçons** **Lemniscates** **Scalar** **Resultant** **Vector-Valued Function** **Newton's Second Law of Motion** **Orthogonal**	How do we sketch velocity and acceleration vectors in a coordinate plane?	12.3 Velocity and Acceleration	

Summary & Extension of Topics			6th 6 Weeks		
Date Taught	**AP Required Elements**	**Content/Vocabulary**	**Guiding Questions**	**Activities**	**Resources**
	I. Functions, Graphs, and Limits II. Derivatives III. Applications of Derivatives IV. Antiderivatives V. Applications of Integrals VI. Polynomial Approximations and Series			Review all AP Required Elements Practice AP tests Projects and Labs	**District Resources** Larson Calculus 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 **Internet Resources** MISD Mathematics Web Site AP Central EduSpace CalcChat Larson Calculus **Manipulatives** **Campus Resources** To be filled in by each campus