

## Williamsville C.U.S.D. #15 Mathematics Curriculum

Program Title: A.P. Calculus

Program Description: AP Calculus is a full-year course. This course follows the recommendations of the committee on Mathematics of the Advanced Placement Program. Topics covered will be: review of trigonometry and other functions, limits, derivatives, basic integration and anti-derivatives, applications of the derivative and integral, calculus with logarithmic and exponential functions, advanced integration techniques. All students will have the option to take the AP exam in May.

Program Content: AP Calculus is a coordination of all the arithmetic and mathematics which the students have had as it is applied to new and advanced ideas.

### Program Guide

Month	Content	Skills	Learning Standards
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August and September

Review of Pre-Calculus; Functions and Graphs

Graph different types of equations.

8.A.3b

Find intercepts of a graph.

8.D.5

Interpret the symmetry of a graph.

8.A.5

Find points of intersection.

8.D.5

Find and apply the use of the Slope of a Line.

7.B.4

Find equations of lines.

8.B.5

Graph Linear Models.

8.B.3

Working with parallel and Perpendicular Lines.

7.B.4

Understand and use function notation.

8.B.5

Use graphing techniques of certain functions with transformations.

8.C.4a, 8.B.4b

Use the Combination of Functions

8.B.5

Find and use the domain and the range of certain functions

8.A.4B

Use models of data to come up with different functional equations used in everyday situations.

8.C.4b

Conic Sections

Understand the different types of conics.

8.A.4b, 8.B.4b

Find the standard equation of the circle.

9.B.4, 8.A.5

Analyze the definitions of all of the conics.

9.B.4

Graph the circle, using the center and the radius.

9.B.4, 8.A.5

Find the standard equation of the parabola.

8.A.5

		Graph the parabola, using the vertex, the latus rectum, the directrix, and the focus.	9.B.4, 8.A.5
		Find the equation of the ellipse.	8.A.5
		Graph the ellipse using the center, the length of the minor and major axis, and the foci.	9.B.4, 8.A.5
		Find the equation of the hyperbola.	8.A.5
		Graph the hyperbola using the center, asymptotes, and the foci.	9.B.4, 8.A.5
		Solve applied problems using the conics.	9.C.5B
	Limits	Find Limits Graphically	8.B.5
		Find Limits Numerically	7.A.4a
		Find Limits Analytically	6.C.5
		Understand the limit process.	8.A.5
		Use the formal definition of a limit to show that limits exist.	9.C.4c
		Determine the non-existence of limits.	8.B.4a
		Define continuity of a function at a certain point.	8.B.3
		Work with one-sided limits and their influence of continuity.	8.B.3
		Understand and apply the Intermediate value theorem.	8.A.5

October	Limits (continued)	Study limits that approach infinity.	8.B.3
		Study limits at infinity.	8.D.4
		Apply limits that approach infinity to vertical asymptotes.	8.B.3, 8.B.5
		Apply limits at infinity to horizontal asymptotes.	7.B.4, 8.C.5
	Derivatives	Use secant lines to define the derivative.	7.B.4, 8.C.5
		Use the derivative as an instantaneous rate of change.	8.B.4a
		Find derivatives as the definition of a limit.	6.C.4
		Understand the relationship between differentiability and continuity.	9.C.4c
		Find the equation of a line tangent to a function.	7.B.4
		Approximate rate of change from graphs and tables of values.	8.C.4a
Find the instantaneous rate of change using the average rate of change.	7.C.4c		
Use basic rules of differentiation to find the derivatives of certain functions. These rules are: The Constant Rule, The Power Rule, The Sum and Difference Rules, The Product and Quotient Rules, Derivatives of Trig Functions, The Chain Rule, Implicit Differentiation.	8.A.5, 8.B.5, 6.B.5, 6.A.5		
Use Implicit Differentiation to solve			

		Related Rate Problems	8.A.5
		Use rates of change to with the position function to find the velocity and acceleration due to gravity.	9.C.5b

<p>November and December</p>	<p>Applications of the Derivative</p>	<p>Use the first derivative to find maximums and minimums of a function.</p>	<p>8.D.4</p>
		<p>Use the first derivative to find where a function is increasing and decreasing.</p>	<p>8.B.3, 8.D.4</p>
		<p>Prove the mean value theorem and its importance for the first derivative test.</p>	<p>9.C.4c</p>
		<p>Use the second derivative to find maximum and minimums of functions.</p>	<p>8.B.3, 8.D.5</p>
		<p>Use the second derivative to find concavity of a function.</p>	<p>8.B.3, 8.D.5</p>
		<p>Use the second derivative to find points of inflection.</p>	<p>8.B.3, 8.D.5</p>
		<p>Sketch graphs of functions using the first and second derivative tests along with all knowledge of limits with asymptotes.</p>	<p>8.B.3, 8.D.5</p>
		<p>Apply the derivative to find maximums and minimums of functions.</p>	<p>7.C.5b</p>
	<p>Prepare for the Semester Exam</p>	<p>Using study guides and Advanced Placement Guides review limits and the derivative.</p>	<p>Review of all state goals mentioned above.</p>

<p>January</p>	<p>Anti-Derivatives and Definite Integration</p>	<p>Review Sigma Notation</p> <p>Use the sum of rectangles to estimate the area under a curve.</p> <p>Find anti-derivatives based on knowledge of derivatives.</p> <p>Relate the area under the curve to the definite integral.</p> <p>Use the Fundamental Theorem of Calculus to evaluate definite integrals.</p> <p>Relate anti-derivatives to the acceleration and velocity function.</p>	<p>6.C.4</p> <p>6.C.4, 7.B.5</p> <p>7.B.5</p> <p>7.B.5</p> <p>8.A.5</p> <p>7.C.4c</p>
<p>February</p>	<p>Definite Integration and Anti-derivatives (continued)</p>	<p>Use the Fundamental Theorem of Calculus to further develop the connection of the derivative and the integral.</p> <p>Use the mean value theorem for integration.</p> <p>Find the average value for a function using integration.</p> <p>Use numerical approximations to find definite integrals.</p>	<p>8.A.5</p> <p>7.B.5</p> <p>8.A.5</p> <p>8.B.5</p>

<p>March</p>	<p>Applications of Integration</p>	<p>Find the area between two curves.</p> <p>Find the volume of a rotating region with an axis by using the disk and washer method.</p> <p>Find the volume of a rotating region with an axis by the shell method.</p> <p>Find arc length and surface area of a surface of revolution.</p> <p>Apply integration to solve work problems.</p> <p>Apply integration to solve fluid force and fluid pressure problems,</p>	<p>7.B.5</p> <p>7.B.5, 7.C.5b</p> <p>7.C.5B</p> <p>7.C.5B</p> <p>7.C.5B</p> <p>7.C.5B</p>
<p>April</p>	<p>Calculus of Logarithmic, Exponential, and other Transcendental Functions</p>	<p>Review logarithms, and the natural exponential functions.</p> <p>Find the derivatives of logarithmic functions.</p> <p>Do integration using logarithms.</p> <p>Find the integration of basic trig functions.</p> <p>Review of inverse functions.</p> <p>Use inverse functions with Calculus.</p> <p>Differentiate and Integrate exponential functions.</p> <p>Apply calculus to solve for Growth and Decay Problems.</p> <p>Inverse Trig Functions and Differentiation.</p> <p>Introduce Hyperbolic Functions and the differentiation of these functions.</p>	<p>6.D.5, 8.C.5</p> <p>8.A.5</p> <p>8.A.5</p> <p>8.A.5</p> <p>8.C.3</p> <p>8.A.5</p> <p>8.A.5</p> <p>6.D.5, 7.A.5, 8.B.5</p> <p>8.A.5, 8.C.5, 8.B.5</p> <p>8.A.5, 8.B.5</p>

May	Integration Techniques and L'Hopital's Rule	Use Integration By Parts.	8.A.5
		Integrate higher powers of Trig Functions.	8.A.5
		Integrate using Trig Substitution.	8.A.5, 8.B.5
		Integrate with Partial Fractions.	8.A.5, 8.B.5
		Use L'Hopital's Rule to find limits.	8.A.5

### Mathematics Learning Standards

(By the end of the course, students should be able to . . .)

State Goal 6: Demonstrate and apply a knowledge and sense of numbers, including numeration and operations (addition, subtraction, multiplication, and division), patterns, ratios, and proportions.

1. Identify and apply the associative, commutative, distributive, and identity properties of real numbers, including special numbers such as pi and square roots.
2. Perform addition, subtraction, and multiplication of complex numbers and graph the results in the complex plane.
3. Identify, represent, and apply numbers expressed in exponential, logarithmic and scientific notation using contemporary technology.
4. Determine the level of accuracy needed for computations involving measurement and irrational numbers.
5. Solve problems involving loans, mortgages, and other practical applications involving geometric patterns of growth.

State Goal 7: Estimate, make and use measurements of objects, quantities and relationships and determine acceptable levels of accuracy.

1. Apply formulas in a wide variety of theoretical and practical real-world measurement applications involving perimeters, area, volume, angle, time, temperature, mass, speed, distance, density, and monetary values.
2. Make indirect measurements, including heights and distances, using proportions (e.g., finding the height of a tower by its shadow).

State Goal 8: Use algebraic and analytical methods to identify and describe patterns and relationships in data, solve problems and predict results.

1. Use algebraic methods to convert repeating decimals to fractions.
2. Represent mathematical patterns and describe their properties using variables and mathematical symbols.
3. Represent algebraic concepts with physical materials, words, diagrams, tables, graphs, equations, and inequalities and use appropriate technology.
4. Use the basic functions of absolute value, square root, linear, quadratic, and step to describe numerical relationships.
5. Analyze and report the effects of changing coefficients, exponents, and other parameters on functions and their graphs.

6. Apply algebraic properties and procedures with matrices, vectors, functions, and sequences using data found in business, industry, and consumer situations.
7. Formulate and solve linear and quadratic equations and linear inequalities algebraically and investigate nonlinear inequalities using graphs, tables, calculators, and computers.
8. Solve mathematical problems involving recursive patterns and use models that employ such relationships.
9. Use functions including exponential, polynomial, rational, parametric, logarithmic, and trigonometric to describe numerical relationships.
10. Use polynomial, exponential, logarithmic, and trigonometric functions to model situations.
11. Formulate and solve nonlinear equations and systems including problems involving inverse variation and exponential and logarithmic growth and decay.

State Goal 9: Use geometric methods to analyze, categorize and draw conclusions about points, lines, planes, and space.

1. Analyze and solve problems involving triangles (e.g., distances which cannot be measured directly) using trigonometric ratios.
2. Use geometric figures and their properties to solve problems in the arts, the physical and life sciences, and the building of trades, with and without the use of technology.
3. Apply physical models, graphs, coordinate systems, networks, and vectors to develop solutions in applied contexts (e.g., bus routing, areas of irregular shapes, describing forces and other physical quantities).

State Goal 10: Collect, organize and analyze data using statistical methods; predict results; and interpret uncertainty using concepts of probability.

### Selected References and Other Materials\*

Textbook: *Calculus 6<sup>th</sup> Edition. Houghton Mifflin*

Teaching Resources: *Using the TI-82*  
*Making Algebra Fun*

Readings:

Films and Videotapes:

Audiotapes and CDS:

Computer Software: Geometers Sketchpad

Internet Sites:

Equipment: Overhead Projector and Screen

\*Key to Symbols Used: C = County Cooperative Film Library; S = Williamsville C.U.S.D. #15 libraries; and P = teacher's personal library.

Field Trips:

## Assessment

Worksheets  
Section Quizzes  
Chapter Tests  
Semester Exams  
AP Calculus Exam (Optional)  
AP Calculus Review Booklet (Optional)