

**SPRINGFIELD PUBLIC SCHOOLS**  
**AP CALCULUS**

**Course Description**

The mathematics of calculus is based on the concept of a limit and includes the study of functions and limits/differentiation and instantaneous rates of change; curve sketching; extreme value problems; antidifferentiation; definite integration and areas under curves and the volumes of solids. This course prepares students for the Calculus Advanced Placement Test for college credit. Dual enrollment for college credit may be available. Inquire at your high school. Prerequisite: C or better in Math Analysis/Trigonometry.

**Course Rationale**

Calculus gives students the opportunity to take a college-level course during high school with the possibility of testing out of the first one or two courses in Calculus in college. Taking AP Calculus gives students planning a major in mathematics, science, or advanced technology the advantage of having part of the Calculus requirement completed as an entering college freshman. Students will be involved in learning how to communicate information mathematically, solve problems from a real-world context, and justify the solutions.

**Major Instructional Goals**

The intent of Springfield R-12 High School Mathematics Program is to explore, investigate, and understand the importance of mathematics through real-world experiences. In mathematics, students will acquire the knowledge and skills to problem solve, communicate, reason, create models, and make connections. Students will:

1. Apply concepts of **Number and Operations** including:
  - a. State, give examples, counterexamples, and graphical representations for the major theorems for limits and continuity. (MA1; 1.6, 1.8, 3.3)
  - b. Evaluate the limits of polynomial, rational, and trigonometric functions. (MA4; 1.6, 1.8, 3.2)
  - c. Locate points of discontinuity and conclude on which intervals the function is continuous. (MA1; 1.4, 1.8)
  - d. Apply properties of functions to simplify expressions or solve equations. (MA4; MA5; 1.6, 1.10)
  - e. Judge the reasonableness of numerical computations and their results. (MA1; MA4; 4.1)
  
2. Apply concepts of **Algebraic Relationships** including:
  - a. Formulate the definitions and rules related to derivatives. (MA1; 1.2)
  - b. Calculate the derivative of polynomial, rational, trigonometric, inverse trigonometric, exponential, and logarithmic functions. (MA4; 1.7)
  - c. Apply the Mean Value Theorem for integration for definite integrals and the Fundamental Theorem of Calculus. (MA1; 3.5)
  - d. Use the mid-point and trapezoidal rules to approximate definite integrals. (MA1; 2.2)

- e. Understand and compare the properties of exponential, polynomial, rational, logarithmic, and periodic functions. (MA4; 1.6, 3.6)
  - f. Describe and use algebraic manipulations of functions. (MA4; 3.1, 4.1)
  - g. Use and solve systems of equations or inequalities. (MA4; 1.6, 3.4)
  - h. Analyze rational, polynomial and periodic functions by investigating rates of change, intercepts, and asymptotes. (MA4; 1.6, 4.1)
3. Apply concepts of **Geometric and Spatial Relationships** including:
- a. Use derivatives in graphical analysis of the function. (MA6; 2.1, 3.6)
  - b. Analyze the function based on the first and second derivative tests for critical points and concavity as aids in graphing functions. (MA4; 1.6, 4.3)
  - c. Examine and apply Rolle's and Mean Value Theorem. (MA1; 1.3, 2.1)
  - d. Use the derivative in solving practical problems. (MA1; 1.4, 1.6)
  - e. Evaluate the definite integral to find the area of a region bounded by two curves and to find distance along the line. (MA2; 2.5, 3.3)
  - f. Calculate the volumes of solids of revolution. (MA2; 2.5, 3.3)
  - g. Solve antidifferentiation problems including rectilinear motion and exponential growth and decay. (MA1; 3.3, 4.1)
  - h. Use Cartesian coordinates and other coordinate systems to analyze geometric situations. (MA2; 3.6, 4.1)
  - i. Recognize three-dimensional objects and spaces from different perspectives and analyze their cross sections. (MA2; 3.6)
  - j. Draw or use visual models to represent and solve problems. (MA2; 3.1)
4. Apply concepts of **Measurement** including:
- a. Approximate the area under the graphs of functions by using partitioning and summation. (MA2; 2.1, 3.6)
  - b. Evaluate indefinite integrals by using the properties and rules of integration. (MA1; 1.6, 1.9)
  - c. Solve differential equations using separation of variables. (MA1; 1.6, 2.4)
  - d. Apply concepts of successive approximation, upper and lower bounds and limit in measurement situations. (MA2; 1.6, 3.4)
  - e. Use unit analysis to solve problems involving rates. (MA4; 3.1)