

# Unit 4 Applications of Derivatives Part I

Content Area: **Mathematics**  
Course(s): **AP Calculus AB**  
Time Period: **October**  
Length: **Approximately 10 blocks**  
Status: **Published**

## Transfer Skills

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Students will be able to differentiate functions implicitly. Along with this, students will gain a deeper understanding as to how derivatives can be use to describe the behavior of a function.

## Enduring Understandings

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The derivative has both theoretical and real life applications.

The derivative provides useful information about the behavior of functions and the shapes of graphs.

Understanding the rate of change of a function allows you to predict future behavior.

## Essential Questions

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What does a derivative tell us about a function?

How can the derivative be used to solve optimization problems?

How do rates of change relate in real-life settings?

## Content

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### Vocabulary:

Implicit differentiation, related rates, concavity, point of inflection, second derivative test

## Red Hot Topics:

- \* Finding the zeros of functions.
- \* Evaluating functions
- \* Solving equations

## Skills

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Differentiate equations that are implicitly defined.

Solve related rate problems.

Use the first and second derivative of a function to analytically determine intervals of increasing/decreasing, concave up/down, coordinates of relative extrema, and coordinates of points of inflection.

Understand the graphical and numerical connections between the graphs of  $F(x)$ ,  $F'(x)$ , and  $F''(x)$ .

## Resources

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Single Variable Calculus with Vector Functions by James Stewart Chapters 3-4

AP Calculus AB AP Central at [collegeboard.com](http://collegeboard.com)

Khan Academy: [www.khanacademy.org](http://www.khanacademy.org)

## Standards

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Mathematical Practice For AP Calculus 1: Reasoning with Definitions and Theorems

- Use definitions and theorems to build arguments,
- Justify conclusions or answers, and prove results;
- Confirm that hypotheses have been satisfied in order to apply the conclusion of a theorem;
- Apply definitions and theorems in the process of solving a problem; interpret quantifiers in definitions and theorems;
- Develop conjectures based on exploration with technology;
- Produce examples and counterexamples to clarify understanding of definitions, to investigate whether converses of theorems are true or false, or to test conjectures.

#### Mathematical Practice For AP Calculus 2: Connecting Concepts

- Relate the concept of a limit to all aspects of calculus;
- Use the connection between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process antidifferentiation) to solve problems;
- Connect concepts to their visual representations with and without technology;
- Identify a common underlying structure in problems involving different contextual situations.

#### Mathematical Practice For AP Calculus 3: Implementing algebraic/computational processes

- Select appropriate mathematical strategies;
- Sequence algebraic/computational procedures logically;
- Complete algebraic/computational processes correctly;
- Apply technology strategically to solve problems; attend to precision graphically, numerically, analytically, and verbally and specify units of measure;
- Connect the results of algebraic/computational processes to the question asked.

#### Mathematical Practice For AP Calculus 4: Building notational fluency

- Know and use a variety of notations (e.g.,  $f'(x)$ ,  $y'$ ,  $dy/dx$ );
- Connect notation to definitions (e.g., relating the notation for the definite integral to that of the limit of a Riemann sum);
- Connect notation to different representations (graphical, numerical, analytical, and verbal);
- Assign meaning to notation, accurately interpreting the notation in a given problem and across different contexts.

#### Mathematical Practice For AP Calculus 5: Connecting Multiple Representations

- Associate tables, graphs, and symbolic representations of functions;
- Develop concepts using graphical, symbolical, or numerical representations with and without technology;
- identify how mathematical characteristics of functions are related in different representations;
- Extract and interpret mathematical content from any presentation of a function (e.g., utilize information from a table of values);
- Construct one representational form from another (e.g., a table from a graph or a graph from given information);
- Consider multiple representations of a function to select or construct a useful representation for solving a problem.

#### Mathematical Practice For AP Calculus 6: Communicating

- Clearly present methods, reasoning, justifications, and conclusions;

- Use accurate and precise language and notation;
- Explain the meaning of expressions, notation, and results in terms of a context (including units);
- Explain the connections among concepts;
- Critically interpret and accurately report information provided by technology;
- Analyze, evaluate, and compare the reasoning of others

MA.F-BF.A	Build a function that models a relationship between two quantities
MA.F-BF.A.1	Write a function that describes a relationship between two quantities.
MA.F-IF.A.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If $f$ is a function and $x$ is an element of its domain, then $f(x)$ denotes the output of $f$ corresponding to the input $x$ . The graph of $f$ is the graph of the equation $y = f(x)$ .
MA.F-IF.A.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.