# Unit 2 Understanding the Derivative

Content Area: **Mathematics**
Course(s): **AP Calculus BC**
Time Period: **September**
Length: **Approximately 8 blocks**
Status: **Published**

## Transfer Skills

Using derivatives to describe the rate of change of one variable with respect to another variable allows students to understand change in a variety of contexts. Students build the derivative using the concept of limits and use the derivative primarily to compute instantaneous rate of change of a function. Applications of the derivative include finding the slope of the tangent line to a graph at a point, analyzing the graph of the function.

## Enduring Understandings

The derivative of a function is defined as the limit of a difference quotient and be determined using a variety of strategies.

A function's derivative, which itself is a function, can be used to understand the behavior of a function.

## Essential Questions

Why is the derivative important?

How is the average rate of change related to the instantaneous rate of change?

How is the derivative related to the tangent line to a curve?

## Content

**Vocabulary:**

definition of derivative, difference quotient, tangent line, normal line, average rate of change, instantaneous rate of change, derivative, power rule, relative extrema, relative maximum, relative minimum, absolute extrema, absolute maximum, absolute minimum, tangent line approximation, L'Hopital's Rule

**Red Hot Topics:**

* Rational Exponents

* Simplifying expressions

* Writing linear equations

* Average rate of change

## Skills

Find an equation of the derivative of a function as a limit of the difference quotient.

Estimate the value of the derivative of a function at a point graphically and numerically and use the value of the derivative to find an equation of a tangent line drawn to the graph of a function.

Analytically find the derivative of a polynomial, sine, or cosine function, and use it to find the equation of a tangent line.

Analytically find the first derivative of a polynomial, sine, or cosine function and use it to find intervals of increasing, decreasing, and relative maximums/minimums for the graph of the function.

Solidify the concept of the derivative being the tangent line and learn to approximate the value of a function using the equation of the tangent line.

## Resources

Single Variable Calculus with Vector Functions by James Stewart Chapter 2-3

AP Calculus BC AP Central at collegeboard.com

Khan Academy: www.khanacademy.org

## Standards

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

- 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

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| MA.F-IF.B.6 | Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. |
| 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. |