# AP Calculus BC Parent Guide

EAGLE MOUNTAIN SAGINAW ISD
Curriculum and Instruction

**Unit 1 Concepts:**

Limits; Continuity and Discontinuities; Horizontal Asymptotes; Intermediate Value Theorem

**Learning Goals:**

In Unit 1, students will learn about limits of functions, from graphs, tables and equations, and then connect limits to a formal definition of continuity. From there, we will discuss types of discontinuity, such as vertical asymptotes and how they violate the definition of continuity. We will wrap up the unit by discussing end behavior and the Intermediate Value Theorem.

**Why?** – Limits are the foundation of Calculus. Calculus is literally the "mathematics of motion" and the motion is created by limits. We will be returning to the idea of limits multiple times throughout the course.

## 1st Six Weeks




**Unit 1: Limits & Continuity**

## 1st Six Weeks

**Unit 2: Differentiation – Definition & Basic Derivative Rules**

**Unit 2 Concepts:**

Average Rate of Change; Definition of the Derivative; Power Rule; Basic Derivative Properties and Rules; Product and Quotient Rule

**Learning Goals:**

In Unit 2, students will apply their knowledge of limits to the limit definition of the derivative. We will analyze how differentiability relates to the slope of a curve, and how it relates to the continuity of the curve. We will finish this topic by discussing the basic derivative rules, such as the Power Rule, Product Rule, Quotient Rule.

**Why?** – Derivatives are a way of representing the rate of change of a quantity. As all things ultimately change, we can mathematically represent that using derivatives.

**Unit 3 Concepts:**

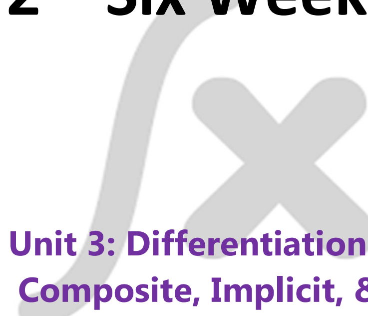
The Chain Rule; Implicit Differentiation; Derivatives of Inverse Functions; Higher-Order Derivatives

**Learning Goals:**

In Unit 3, students will build on their derivative knowledge by discussing composite and implicit functions. We will be able to determine the derivative by applying the Chain Rule for composite functions. We will end the unit by determining second and third derivatives by applying all our derivative rules and properties from units 2 & 3.

**Why?** – Every single function can be viewed as a composite function. The Chain Rule is the basis for taking derivatives of just about any function, both explicit and implicit. We will require this as we move through to applications of derivatives.

## 2nd Six Weeks



**Unit 3: Differentiation – Composite, Implicit, & Inverse Functions**

**Unit 4 Concepts:**

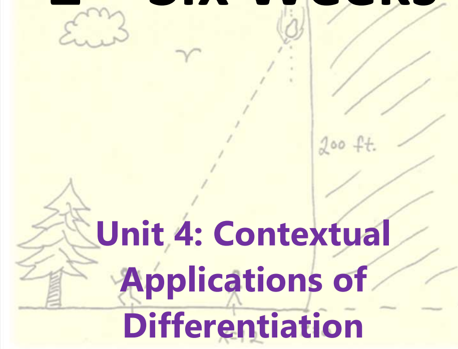
Derivatives in Context; Straight-Line Motion; Related Rates; Tangent Line Approximations; L'Hospital's Rule

**Learning Goals:**

In Unit 4, students will apply derivatives for the first time to real-world contextual problems. We will demonstrate the connection between position, velocity, and acceleration, and then solve problems where rates of change are related to each other by time. We will wrap up the unit by applying L'Hospital's Rule for evaluating limits of indeterminate form.

**Why? –** Derivatives represent the rate of change of a quantity, so this unit is all about determining the relationships between rates of change, like position and velocity or volume and height of the water-level.

## 2nd Six Weeks




**Unit 4: Contextual Applications of Differentiation**

## 3rd Six Weeks


**Unit 5: Analytical Applications of Differentiation**

**Unit 5 Concepts:**

Mean Value Theorem; Extreme Value Theorem; Increasing vs. Decreasing; Concavity; First Derivative Test; Second Derivative Test; Candidates Test; Optimization

**Learning Goals:**

In Unit 5, students will use differentiation to maximize or minimize quantities. We will start by discussing our 2nd Big Theorem, the Mean Value Theorem, followed by the Extreme Value Theorem. We will then build our vocabulary with increasing, decreasing, and concavity. We will finally discuss relative extrema by applying the First Derivative Test or the Second Derivative Test and optimize real world problems.

**Why? –** Most real-world tasks involve optimizations, maximizing profit, minimizing costs, getting the most "bang for your buck". In Unit 5, we use calculus to help us optimize functions and real-world scenarios.

**Unit 6 Concepts:**

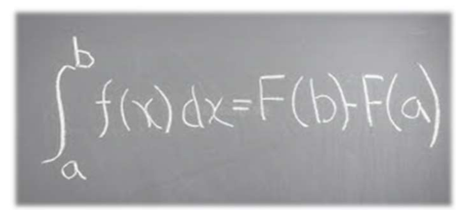
Riemann Sums; Fundamental Theorem of Calculus; Accumulation of Change; Indefinite vs. Definite Integrals; Integration Techniques (Substitution, Integration by Parts, Partial Fractions); Improper Integrals

**Learning Goals:**

In Unit 6, students will begin the second half of calculus, integration. We will approximate the area under a curve by applying Riemann Sums, and then build a definition for the definite integral, finishing with the Fundamental Theorem of Calculus. We will then build on that by learning other integration techniques to solve a variety of integration problems. BC will then learn about Advanced Integration and improper integrals.

**Why? -** Integration is the opposite of differentiation, so if we have been focusing on taking/applying derivatives, isn't it time we learned how to "undo" that process, and what that might mean?

## 3rd/4th Six Weeks




**Unit 6: Integration & Accumulation of Change**

**Unit 7 Concepts:**

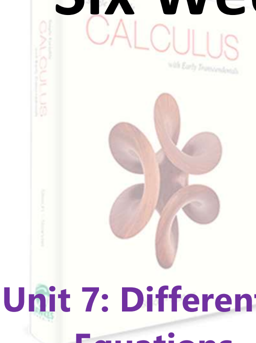
Modeling Situations; Slope Fields; Euler's Method; General vs. Particular Solutions of Differential Equations; Exponential Models; Logistic Models

**Learning Goals:**

In Unit 7, students will apply their integration techniques to differential equations. We will start by graphing solutions by using slope fields, and then we will approximate solutions with Euler's Method. Next, we will solve differential equations by applying separation of variables. We will end the unit by applying differential equations to real-world models, such as exponential and logistic growth and decay.

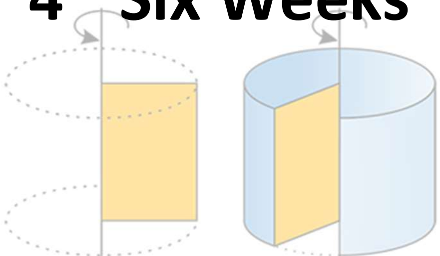
**Why? –** Differential Equations are a common way to represent real-world rates of change. By applying integration techniques, we can determine equations for real-world scenarios, like the growth of a baby bird.

## 4th Six Weeks




**Unit 7: Differential Equations**

## 4th Six Weeks



**Unit 8: Applications of Integration**

**Unit 8 Concepts:**

Average Value; Accumulation in Applications; Area of a Region; Volumes with Cross-Sections; Volumes of Solids of Revolution (Disk Method & Washer Method); Arc Length

**Learning Goals:**

In Unit 8, students will be applying integration techniques to real-world problems involving accumulation of change, such as distance vs. displacement. We will then turn our attention to area between two curves, and then build to three dimensional objects with geometric cross sections. We will then finish by discussing solids of revolution, with the Disk Method and the Washer Method. BC will also discuss arc length.

**Why? –** Integration is used to represent accumulation of change, so our primary focus will be to apply integration techniques in real-world and geometric applications.

**Unit 9 Concepts:**

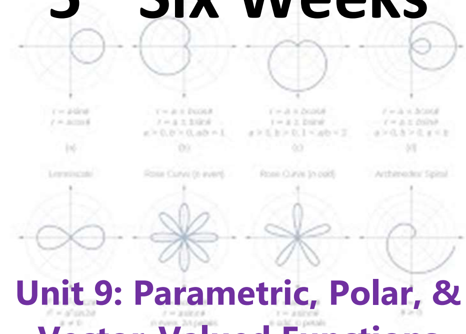
First Derivatives/Second Derivatives of Parametric Equations; Arc Length of Parametrics; Differentiating and Integrating Vector-Valued Functions; Motion Applications; Differentiating Polar Equations; Area of a Polar Curve

**Learning Goals:**

In Unit 9, students will apply all of their knowledge of derivatives and integrals to parametric, and vector-valued functions. We will then focus on the polar coordinate plane and apply our knowledge to polar curves.

**Why? –** In Calculus 2, students are expected to apply what they learned in Calculus 1 to new representations. Parametric equations and vectors require a two-dimensional understanding, and polar curves are based on rotation. How does our understanding of derivatives and integrals carry over to other representations of space?

## 5th Six Weeks



**Unit 9: Parametric, Polar, & Vector-Valued Functions**

Unit 10 Concepts:

Convergence vs. Divergence; Geometric Series; Convergence Tests; Absolute vs. Conditional Convergence; Taylor Polynomials; Power Series; Taylor & Maclaurin Series; Error Bounds

Learning Goals:

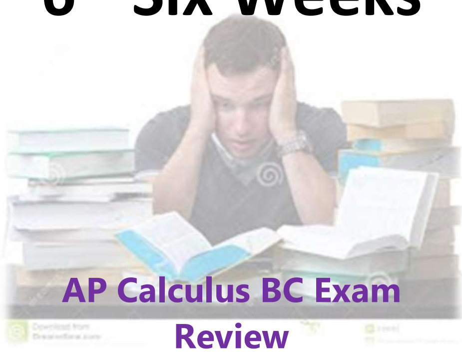
In Unit 10, students will approximate the behavior of a function by constructing infinite series called Taylor (or Maclaurin) Series. We will analyze them on their interval of convergence and use convergence tests to assist us at the endpoints. We will wrap up by representing functions by the more general power series.

**Why? –** Did you know that calculators actually do not understand transcendental functions? They only understand the four basic operations (add/subtract/multiply/divide). Power Series are a way of representing any function via addition and subtraction, in the way a calculator understands it.

# $5^{th}$ Six Weeks


**Unit 10: Infinite Series**

# $6^{th}$ Six Weeks



**AP Calculus BC Exam Review**

Unit 11A Concepts:

AP Review (Multiple Choice; Free Response Questions); Timing Practice; Scoring Overviews

Learning Goals:

Students will review what they know by applying Units 1 – 10 to Multiple Choice and Free Response Questions to prepare for the AP Calculus BC Exam. We will be focusing on answering questions with accuracy and quickly, reviewing the timing expectations and how problems will be scored.

**Why? –** While students have learned all they need to know about Calculus BC, they need to practice taking the actual AP Calculus Exam, and going through released questions to actually do well.

Unit 11B Concepts:

This section is up to your AP Calculus BC Teacher – they will wrap up the year with something fun or relaxing as a reward for rocking that exam!

Learning Goals:

Make it to Graduation.

**Why? –** The students have worked so hard all year, and they deserve a break, or at least a more relaxed learning environment before they graduate. We are so proud of the work they did! Congratulations!

# $6^{th}$ Six Weeks

**After the AP Exam**

**Questions?** Please contact your AP Calculus BC math teacher. **Additional Support:** We recommend Khan Academy and VarsityTutors.com and remember campus tutoring is also available.