# ~~Course~~ Description

**AP® Calculus: Challenging Concepts from Calculus AB & Calculus BC**

We, as co-editors, are so pleased that you are using the Davidson Next AP Calculus program. We have carefully designed this program to help students and teachers learn the most important and challenging concepts in AP Calculus AB and BC. We have carefully chosen fourteen concepts, from Limits to the Series Manipulation. The importance and challenge of these concepts have been affirmed by data relating to AP® test performance in Calculus AB and BC provided by the College Board.

For each of the fourteen concepts, there will be questions to assess whether students are ready for the new material, a video lecture of the material covered, and several assessment questions. All of our presenters are outstanding secondary school teachers with extensive experience in the AP Calculus program. They combine the discipline knowledge to explain the material with the experience of working with high school AP students in these challenging areas.

We are persuaded that if students engage properly the content of a unit and work carefully through all the assessment questions that they will have a very strong mastery of the concept. Such knowledge will serve them well in taking the AP Calculus exam and in taking subsequent courses that build on calculus knowledge.

We are very excited about this novel project. To that end, we so hope that you will provide us any feedback or suggestions to improve this work.

Your co-editors,

Stephen Davis and Benjamin Klein, both of Davidson College (North Carolina)

# Prerequisites

Students embarking on a calculus course should have a solid foundation in pre-calculus: algebraic facility, experience with coordinate geometry, comfort with general function topics (e.g., composition, graphs), and knowledge of particular function types: trigonometric, exponential, and logarithmic.

As mentioned above, the units presented here are selected from those that AP Calculus students often find most challenging. As such, these units do not constitute a full course for either AP Calculus AB or AP Calculus BC, and there may be calculus topics presumed within these units not included among the units. (For example, we do not present the product or quotient rules for derivatives, but it is likely that students will need to apply these rules to solve problems in the unit on the Chain Rule, or in later units.)

Graphing technology provides an important pedagogical platform for exploring and reinforcing calculus topics. As such, appropriate use of a graphing calculator is considered an integral part of an AP Calculus course. At certain junctures we have provided a graphing utility within the edX platform. However, students need to have facility with their own graphing calculator for the AP exam. As AP-approved graphing calculators vary widely in interface, we have not provided specific instruction on calculator use.

# ~~Course~~ Overview and Recommended Usage

**Flexibility in Units**

These 14 units (challenge concepts) were designed with the intent of flexibility. In the introductory overview at the start of each unit you will find a short summary of prerequisites (“prior knowledge”) anticipated for the unit.

Nearly all of units 1 through 10 are topics in Calculus AB. (Exception: the last Learning Cycle on “Logistic Models” in unit 9 is a BC topic. Note that unit 5, L’Hospital’s Rule, will be an AB topic starting with the 2017 exam.) Units 11 through 14 are devoted to Calculus BC topics not included in Calculus AB.

The units are listed in an order that these topics commonly appear in calculus courses, but it should be easy to rearrange them in an order that suits your particular course.

**For Students and Teachers**

The units can be used in a variety of ways:

* by individual students in order to enhance their understanding of particular topics in AP Calculus.
* by teachers as a teaching resource, for example:
  + as a teaching tool to incorporate in their classroom instruction;
  + using videos to facilitate a “flipped” classroom environment;
  + adapting some of the interactive tools for student exploration of calculus concepts.
* as review tutorials before the AP exam, or for just-in-time review during a course.

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| **Unit #** | **Name** | **Unit Author** |
| 1 | Limits | Pario-Lee Law |
| 2 | Definition of Derivative | Larry Peterson |
| 3 | Chain Rule | Monique Morton |
| 4 | Implicit Differentiation | Monique Morton |
| 5 | L’Hospital’s Rule | Mark Howell |
| 6 | Riemann Sums | Peter Atlas |
| 7 | Functions Defined by Integrals | Scott Pass |
| 8 | Modeling with and Solving Differential Equations, I | Jenny Wexler |
| 9 | Modeling with and Solving Differential Equations, II | Jenny Wexler |
| 10 | Rectilinear Motion | Vicki Carter |
| 11 | Parametric Equations | Vicki Carter |
| 12 | Introduction to Series | Jane Wortman |
| 13 | Series Convergence | Jane Wortman |
| 14 | Series Manipulation | Jane Wortman |

# Unit Design and Grading

Each unit has 4 major components.

1. **Overview and Objectives** You will be introduced to the concept and instructor, learning objectives, and a list of important vocabulary.
2. **Let’s See What You Already Know (5%)** These pre-assessment questions test concepts that you should know in order to continue with the unit. Although questions were not meant for teaching purposes, some answers are supported by explanations as a reminder for rusty students.
3. **Learning Cycles (70%)** Each Learning Cycle contains a short video explanation of the concept, a hands-on activity that allows you to practice the concept, and formative assessment questions that include feedback. You can self-assess and teachers can also receive feedback about your understanding.
   1. **Introduction:** The challenge concept addressed in this Learning Cycle is summarized in a brief statement.
   2. **Video Content:** Our experienced AP Calculus instructor explains the concept in the learning cycle.
   3. **Hands-on Activity:**The hands-on activities aim to merge innovative teaching technology with AP focused content. In many cases, we are pushing the boundaries of assessment within the edX platform. Because of the novelty of many of our assessment techniques, these are not always strictly graded, however, we do expect you to take these activities seriously.
   4. **Last Thoughts:** This provides a reminder of the topic addressed in the Learning Cycle and a bridge to the questions testing your understanding of the topic.
   5. **Questions:** These formative assessment questions include detailed solutions for you. You can self-assess and teachers can receive performance data to help them assess your understanding.
4. **Let’s See What You’ve Learned (15%)** These post-assessment questions cover the concepts from the entire unit. Each question is accompanied by a detailed solution to help you better understand the tested concept, as well as by a note indicating where to look in the unit for the information tested in the question.