CLARK UNIVERSITY

Goals
Math 120–121 Calculus I and II

There are a number of different goals for this course. They overlap and interact with each other, so it's difficult to separate them. Nonetheless, we can identify some key points.

Knowledge. Of course, the main goal of the course is your pursuit of knowledge.

You'll learn what Calculus is. You'll see how it developed over a period of centuries starting in the 1300s, when it became an identifiable subject in mathematics in the 1600s, and how it's logical foundations were shored up in the 1800s.

You'll learn how to use Calculus to understand and use changing quantities in mathematics, natural science, social science, and engineering.

The understanding of changing quantities that comes with Calculus has been one of the most important factors in the development of civilization since the 17th century. It remains one of the premier tools of all science and engineering.

Intellectual and Practical Skills. You'll see how to how the concepts of derivative and limit were developed over the centuries. The conversion of these concepts from intuitive but imprecise concepts to formal, precise concepts took a long time.

You'll learn how to use logical evidence to prove properties of limits and derivatives.

You'll use Calculus to solve problems in a variety of subjects. We'll start out with basic examples, but the problems will become progressively more challenging.

Skepticism and the mathematical mind. In elementary school you were probably told how to do things and not so much why. In high school you may have studied Euclidean geometry where the *why* of the geometry is as important as the *what* of geometry.

In college and, generally, in research mathematics, the *why* is always as important as the *what*. The reasoning behind a statement is as important as the statement itself.

Part of this is skepticism, the view that a statement should not be accepted unless you know why it's true. Skepticism is part of the scientific attitude, and it's necessary in mathematics. The refusal to accept statements without proof has led to the creation of much, if not most, of mathematics.

For example, Newton, in his fairly logical development of calculus still implicitly assumed all quantities changed smoothly. In the 19th and 20th centuries that was questioned. One of the results of that skepticism was the whole concept of fractals.

Ability to Integrate Knowledge and Skills You'll connect to other fields in this course including philosphy, history, physics, chemistry, biology, economics, and engineering.

Changing quantities that come from different fields have the same underlying Calculus. Cars travelling down highways, differing sales depending on price, populations of bacteria, ratioactive decay–they're all related by calculus.

Formal Analysis. FA.

Math 120 satisfies one of Clark's requirements in the Program of Liberal Studies, as does Math 121. In the Program of Liberal Studies there are two Critical Thinking Courses, one being Formal Analysis (FA). All Formal Analysis courses include the use of a formal, symbolic language as appropriate for a specific discipline, rules of logic for that language, and the use of that language for modeling the subject matter of the discipline.

In Calculus we'll use the formal, symbolic language of mathematics that you already know from algebra, geometry, trigonometry, and analysis. We'll develop it further with formal definitions and specific notations for Calculus. We'll prove theorems in calculus using strict logical proofs. We'll apply what we develop to model and solve applications in natural and social science.

Math 120 Home Page at `http://math.clarku.edu/~ma120/`
Math 121 Home Page at `http://math.clarku.edu/~ma121/`