

Using History  
to Make Differential Calculus  
Come Alive

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January 13, 2006

At Elon, Calculus I covers limits, differentiation, optimization, and an introduction to integration.

The process goals for the class include:

- Familiarity with using technology (currently the *TI-89* calculator at this level)
- Communication skills (including short papers on topics related to class content)
- Reasoning skills at a developmental level (some brief discussion of the formal definition of limits using  $\delta$  and  $\epsilon$  and deriving differentiation formulae with limits)

These process goals help the students to gain true understanding of the content of the class.

We also feel strongly that the material becomes more tangible if we include some discussion of the history of the development of differential calculus, at a level that is appropriate for freshmen. It is hard for the students to see math as something that is created fresh; all of their lives they have been presented with math as accepted fact in a prescribed order.

For freshmen, many of whom have seen differential calculus content in high school without having mastered it, simple writing assignments can force them to go beyond the formulae that they have memorized.

Many of them actually find it harder to write a short essay than a longer term paper. A short essay forces the students to focus on what is important in the topic, instead of just recycling what they've read with minor re-wording.

The history of calculus offers many different entry points for short, 3–5 page papers:

- Contentions between Newton, Leibniz, and their supporters over primacy
- The history of limits, particularly their chronology with respect to derivatives
- Notational differences for writing derivatives
- First order differentials and Newton's Method
- The work of Archimedes on areas, surface areas, and volumes
- The brachistochrone problem

Sources that I have used:

- *Mathematical Thought from Ancient to Modern Times* by Morris Kline.
- *History of Mathematics* by Florian Cajori.
- *History of the Calculus and its Conceptual Development* by Carl B. Boyer.
- *The Rise of Calculus*,  
[www-history.mcs.st-andrews.ac.uk/history/](http://www-history.mcs.st-andrews.ac.uk/history/)