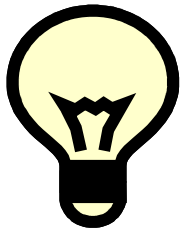
Introduction to Calculus

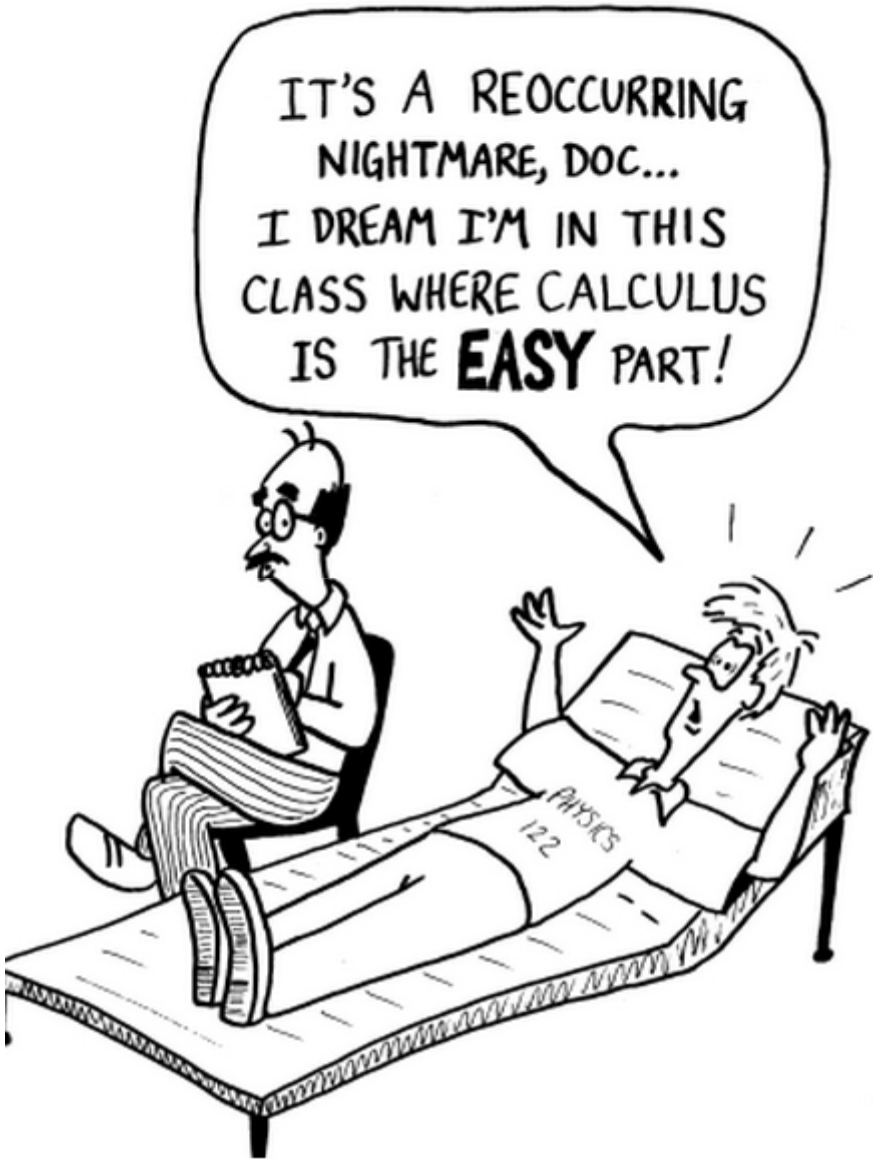
What Do You Think?

- What things could be considered the greatest achievements of the human mind?

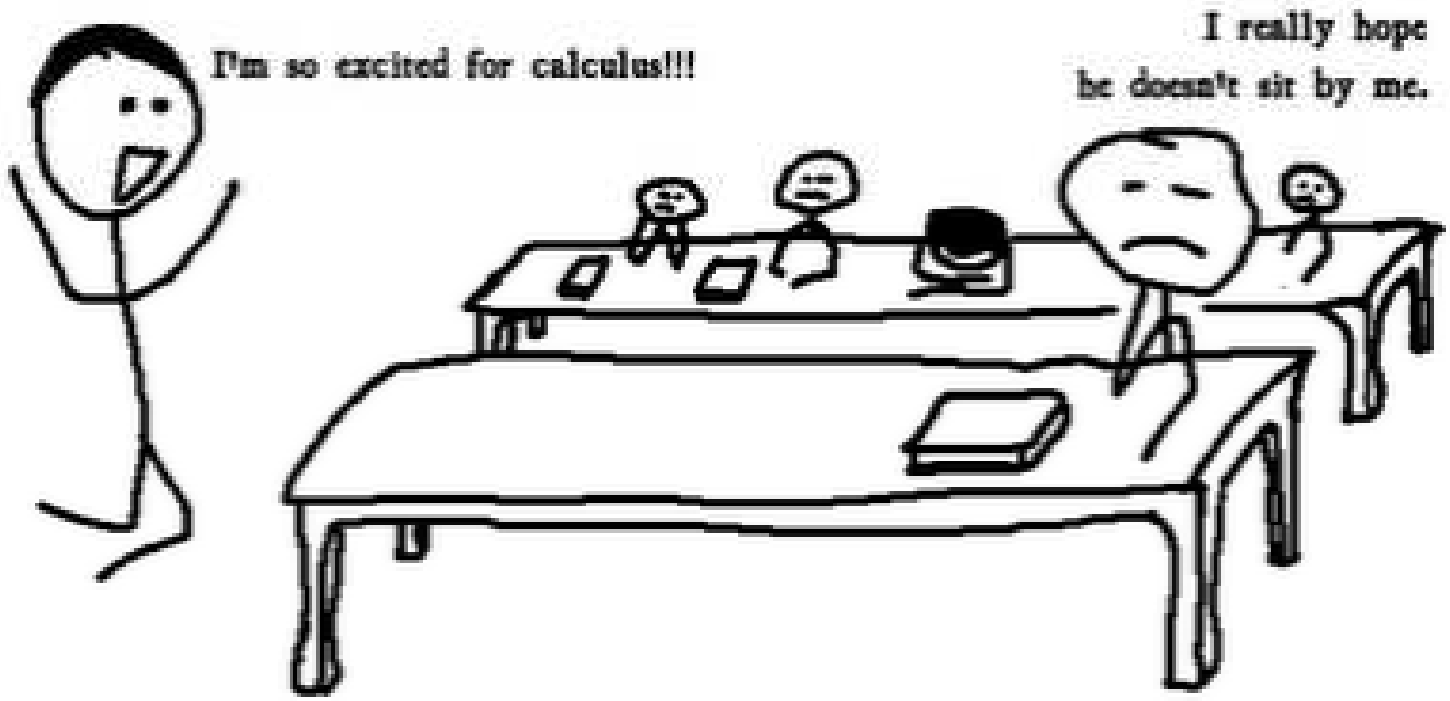


It's the Greatest!

- Consider that all these things emerged because of technological advances
- Those advances relied on CALCULUS !
- Calculus has made it possible to:
  - Build giant bridges
  - Travel to the moon
  - Predict patterns of population change


IT'S A REOCCURRING NIGHTMARE, DOC... I DREAM I'M IN THIS CLASS WHERE CALCULUS IS THE EASY PART!
PHYSICS 122

First Day of Class



True or False?

T F Unless you actually enjoy wearing a pocket protector, you've got no business taking calculus.

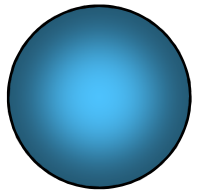
T F Studying calculus is hazardous to your health.

T F Calculus is totally irrelevant.

The Genius of Calculus is Simple

- It relies on only two ideas
  - The Derivative
  - The Integral
- Both come from a common sense analysis of motion
  - Motion is change in position over time
  - All you have to do is drop your pencil to see it happen

What Is Calculus

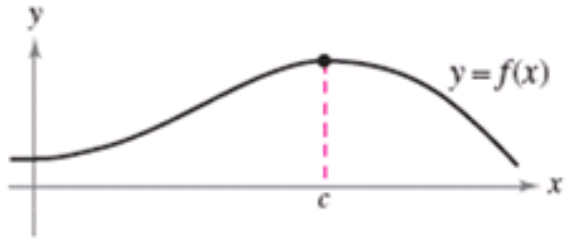
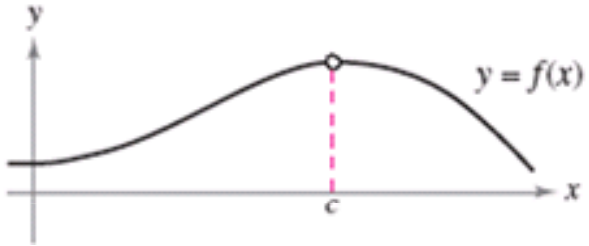


- It is the mathematics of change
- It is the mathematics of
  - tangent lines
  - slopes
  - areas
  - volumes
- It enables us to model real life situations
- It is dynamic
  - In contrast to algebra/precalc which is static

What Is Calculus

- One answer is to say it is a "limit machine"
- Involves three stages
  1. Precalculus/algebra mathematics process
     - Building blocks to produce calculus techniques
  2. Limit process
     - The stepping stone to calculus
  3. Calculus
     - Derivatives, integrals

Contrasting Algebra & Calculus

Without Calculus	With Differential Calculus
	

- Use f(x) to find the height of the curve at x = c
- Find the limit of f(x) as x approaches c

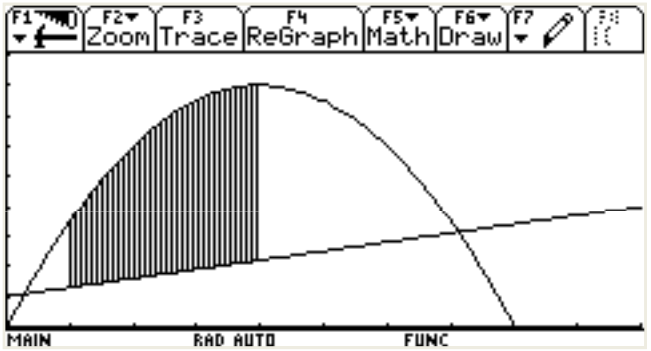
Contrasting Algebra & Calculus

Without Calculus	With Differential Calculus

- Find the average rate of change between $t = a$ and $t = b$
- Find the instantaneous rate of change at $t = c$

Contrasting Algebra & Calculus

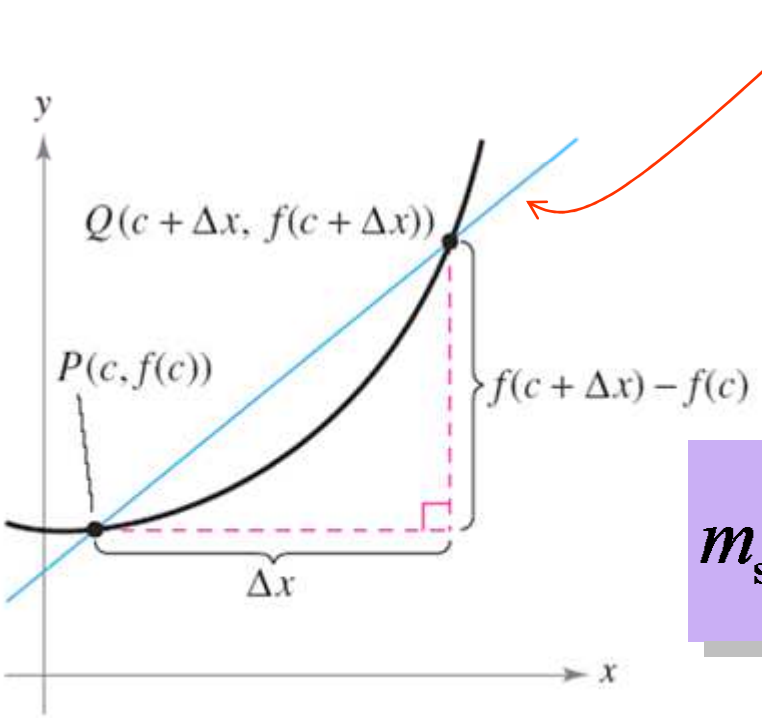
Without Calculus	With Differential Calculus



- Area of a rectangle
- Area between two curves

Tangent Line Problem

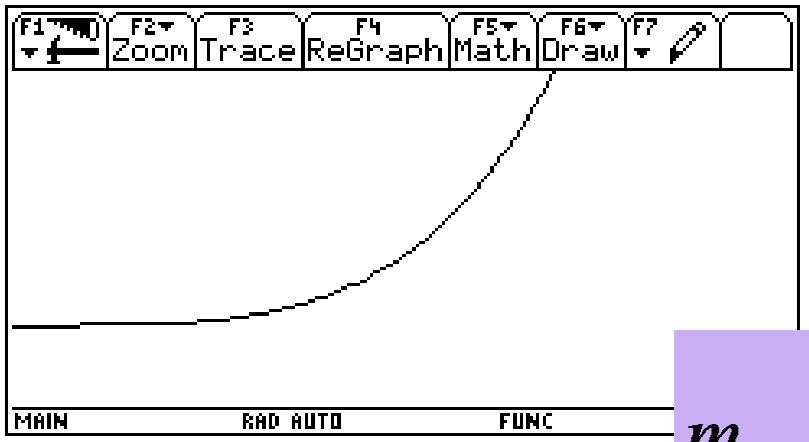
- Approximate slope of tangent to a line
  - Start with slope of secant line



$$m_{\text{secant}} = \frac{f(x+\Delta x) - f(x)}{\Delta x}$$

Tangent Line Problem

- Now allow the Δx to get smaller

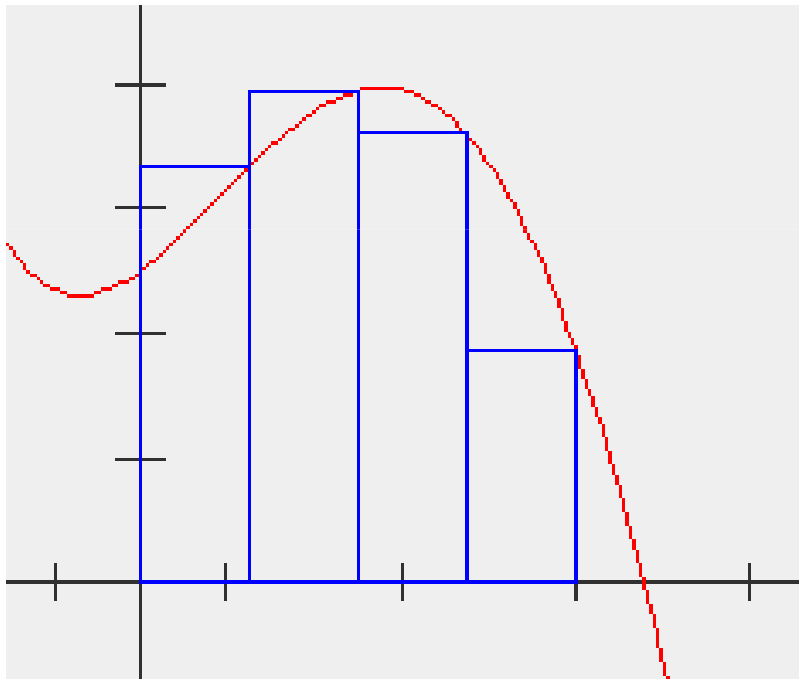


$$m_{\text{tangent}} = \lim_{\Delta x \to 0} \left(\frac{f(x+\Delta x) - f(x)}{\Delta x} \right)$$

The Area Problem

- We seek the area under a curve, the graph f(x)

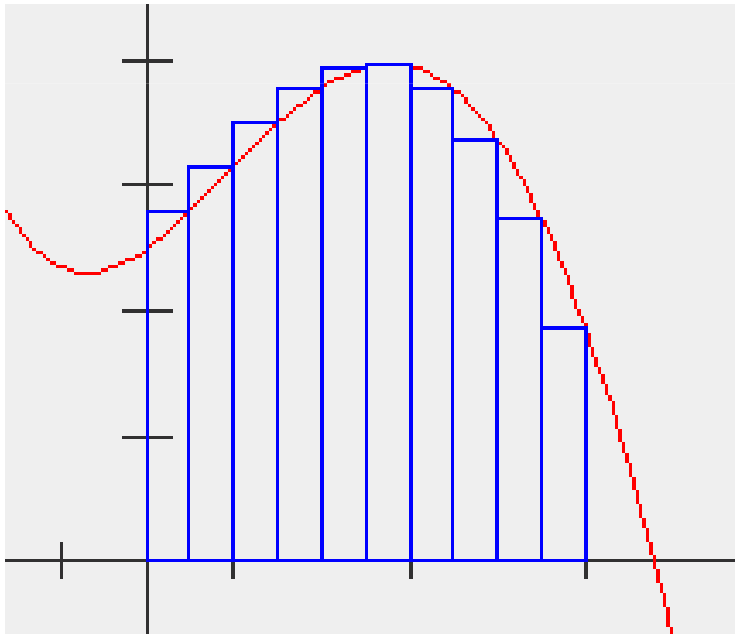
- We approximate that area with a number of rectangles
- Sum = 31.9
- Actual = 33.33



The Area Problem

- The approximation is improved by increasing the number of rectangles

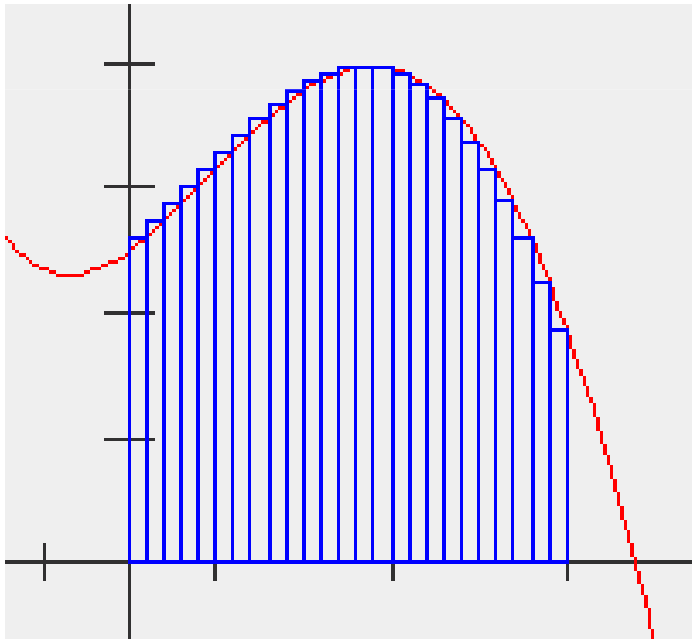
- Number of rectangles = 10
- Sum = 32.92
- Actual = 33.33



The Area Problem

- The approximation is improved by increasing the number of rectangles

- Number of rectangles = 25
- Sum = 33.19
- Actual = 33.33



Thank you

- Questions ?
- What have you learned ?
- What we will see tomorrow ?
- Homework