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A Preview of Calculus



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What Do You Think?

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





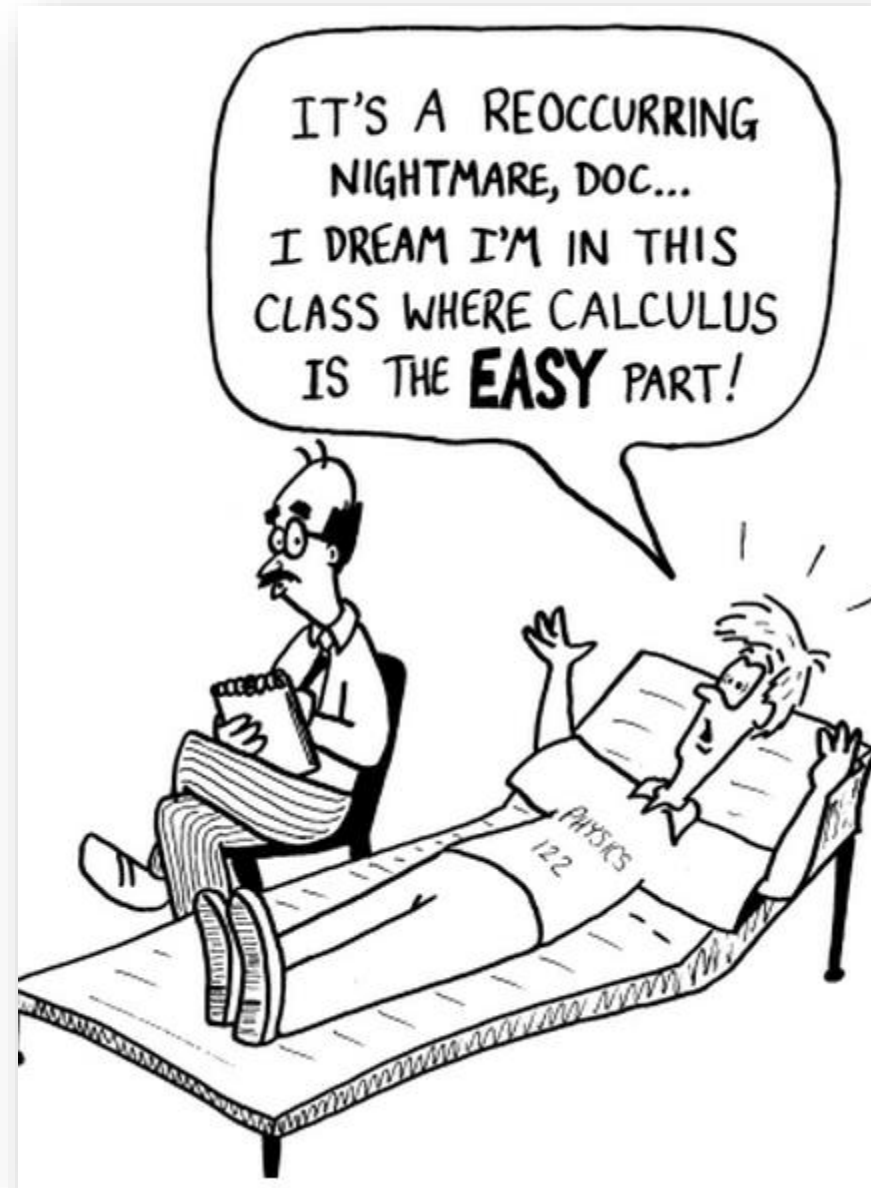
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It's the Greatest!

- 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



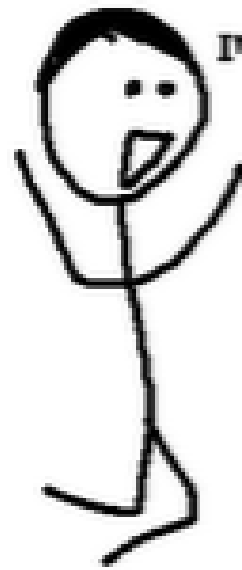
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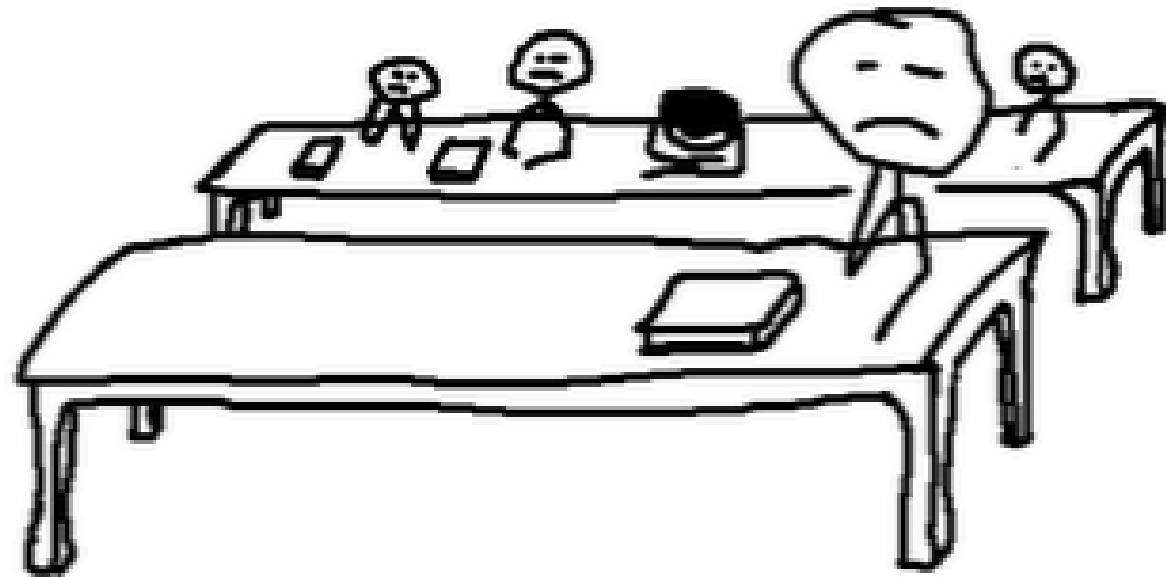
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FIRST DAY OF CLASS



I'm so excited for calculus!!!

I really hope
he doesn't sit by me.





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True or False?

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

T F Studying calculus is hazardous to your health. **False**

T F Calculus is not relevant. **False**



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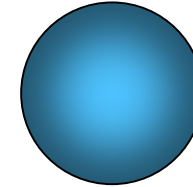
The Genius of Calculus is Simple

- 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



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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



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What Is Calculus

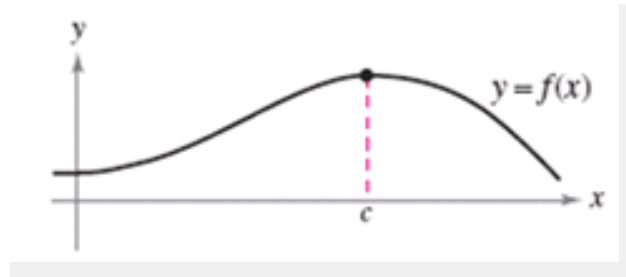
- One answer is to say it is a "limit machine"
- Involves three stages
 1. Precalculus/algebra mathematics process
 - Building blocks to produce calculus techniques
 2. Limit process
 - The stepping stone to calculus
 3. Calculus
 - Derivatives, integrals



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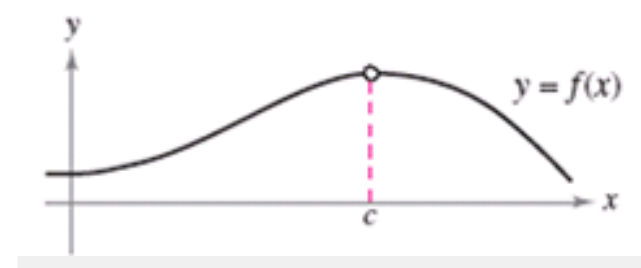
Contrasting Algebra & Calculus

Without Calculus



- Use $f(x)$ to find the height of the curve at $x = c$

With Differential Calculus



- Find the limit of $f(x)$ as x approaches c



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Contrasting Algebra & Calculus

Without Calculus

With Differential Calculus



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

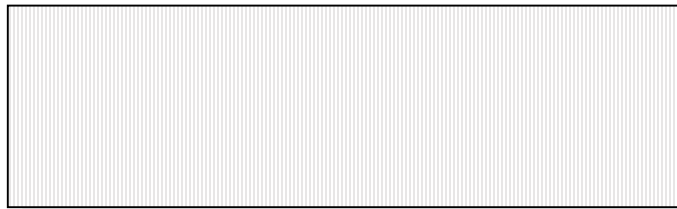
- Find the instantaneous rate of change at $t = c$



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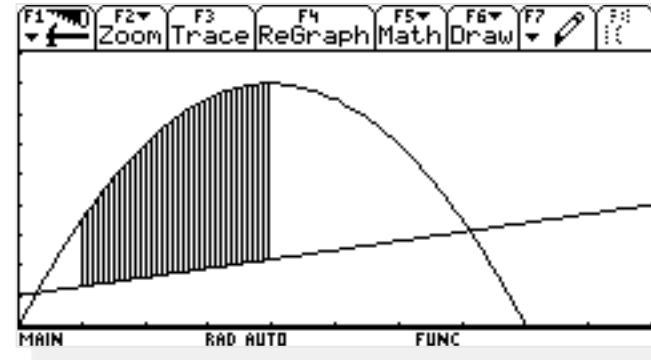
Contrasting Algebra & Calculus

Without Calculus



- Area of a rectangle

With Differential Calculus



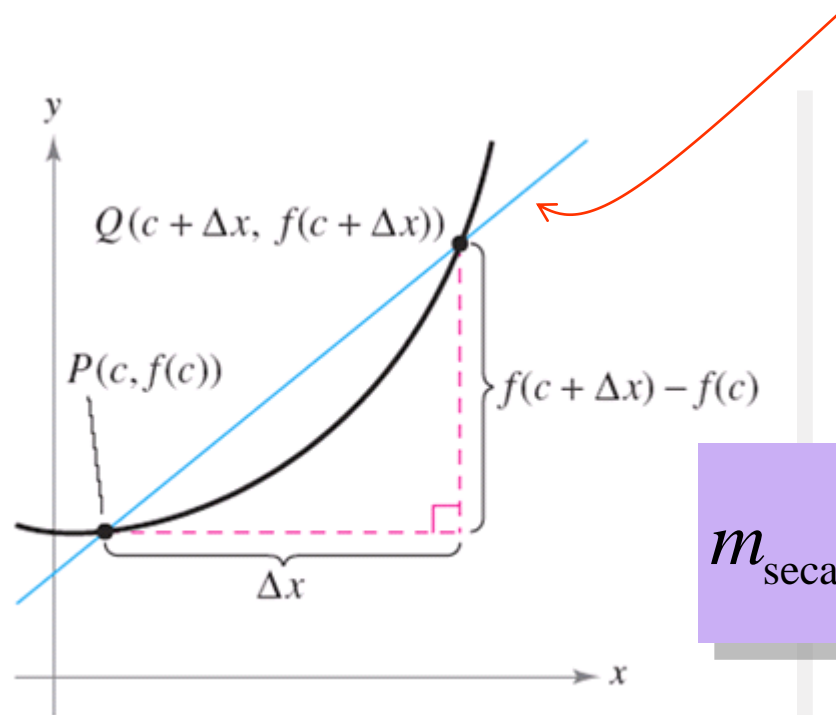
- Area between two curves



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Tangent Line Problem

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



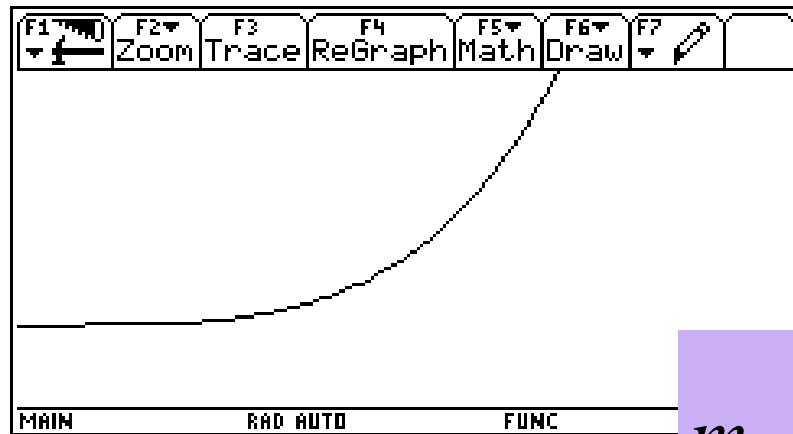
$$m_{\text{secant}} = \frac{f(x + \Delta x) - f(x)}{\Delta x}$$



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Tangent Line Problem

- Now allow the Δx to get smaller



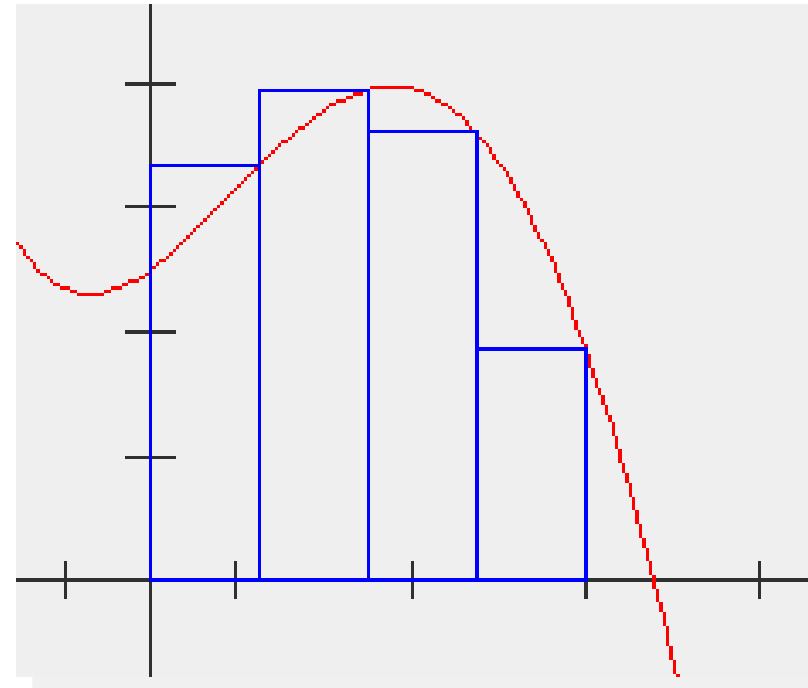
$$m_{\text{tangent}} = \lim_{\Delta x \rightarrow 0} \left(\frac{f(x + \Delta x) - f(x)}{\Delta x} \right)$$



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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

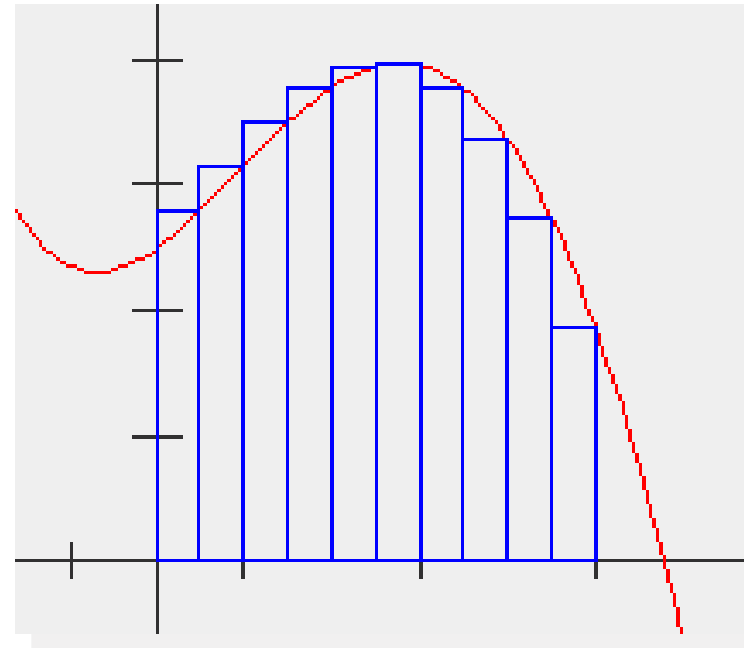




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The Area Problem

- The approximation is improved by increasing the number of rectangles
- Number of rectangles = 10
- Sum = 32.92
- Actual = 33.33

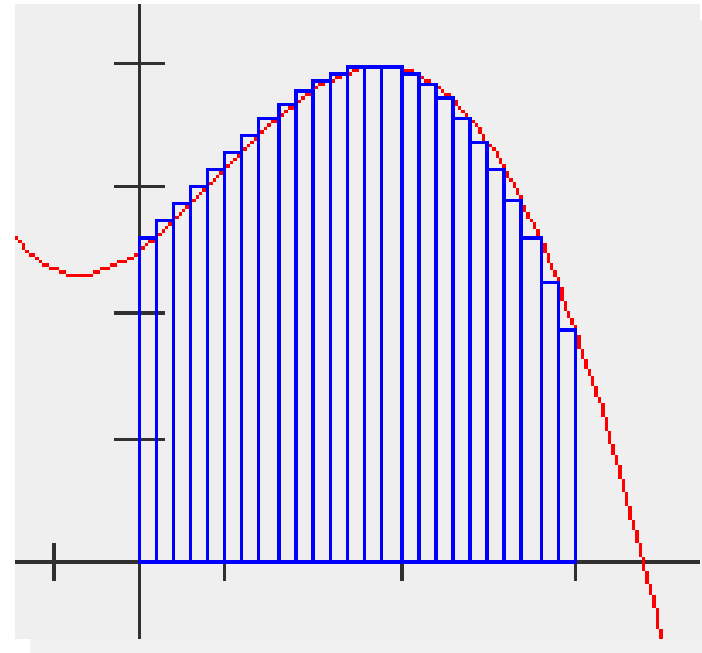




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The Area Problem

- The approximation is improved by increasing the number of rectangles
- Number of rectangles = 25
- Sum = 33.19
- Actual = 33.33



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