

Session #17

Cooperative Activities for Calculus

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Mathematical Practices for AP Calculus

- **MPAC 1: Reasoning with definitions and theorems**
- **MPAC 2: Connecting concepts**
- **MPAC 3: Implementing algebraic/computational processes**
- **MPAC 4: Connecting multiple representations**
- **MPAC 5: Building notational fluency**
- **MPAC 6: Communicating**

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AP Curriculum Framework

Enduring Understandings

(Students will understand that . . .)

EU 2.3: The derivative has multiple interpretations and applications including those that involve instantaneous rates of change.

Learning Objectives

(Students will be able to . . .)

LO 2.3D: Solve problems involving rates of change in applied contexts.

LO 2.3E: Verify solutions to differential equations.

LO 2.3F: Estimate solutions to differential equations.

Essential Knowledge

(Students will know that . . .)

EK 2.3D1: The derivative can be used to express information about rates of change in applied contexts.

EK 2.3E1: Solutions to differential equations are functions or families of functions.

EK 2.3E2: Derivatives can be used to verify that a function is a solution to a given differential equation.

EK 2.3F1: Slope fields provide visual clues to the behavior of solutions to first order differential equations.

EK 2.3F2: (BC) For differential equations, Euler's method provides a procedure for approximating a solution or a point on a solution curve.

Slope Field Activity Day 1

$$y' = y^2 - x^2 \quad y' = \frac{-x}{y} \quad y' = y(3 - y)$$

$$y' = y + x^2 \quad y' = \frac{1}{2}y \quad y' = y + x$$

$$y' = y^2 - x \quad y' = xy \quad y' = \frac{y}{x}$$

$$y' = 2x - 3y + 1$$

Slope Field Activity Day 1

Draw a slope field for your DE

- Use a domain and range of $[-2, 2]$
- Grid marking by 0.25 units
- Draw slopes only on the integer (lattice) points
- What do you notice?
- Draw a solution through $(2, 1)$

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Slope Field Activity Day 2

Draw segments using your slopes

- Start with A (-2, 1)
- Draw a line segment using the slope line at point A with an x-increment of 0.5 (ending at $x = -1.5$)
- Estimate the y-value at this new point B
- Calculate the slope at point B
- Repeat until you reach an x-value of 0

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Slope Field Activity Day 2

Use Euler's Method

- Start with $(-2, 1)$
- Use Euler's method with an x -increment of 0.5 and 4 steps
- Compare this result to the one from your slope field

Slope Field Activity Day 3

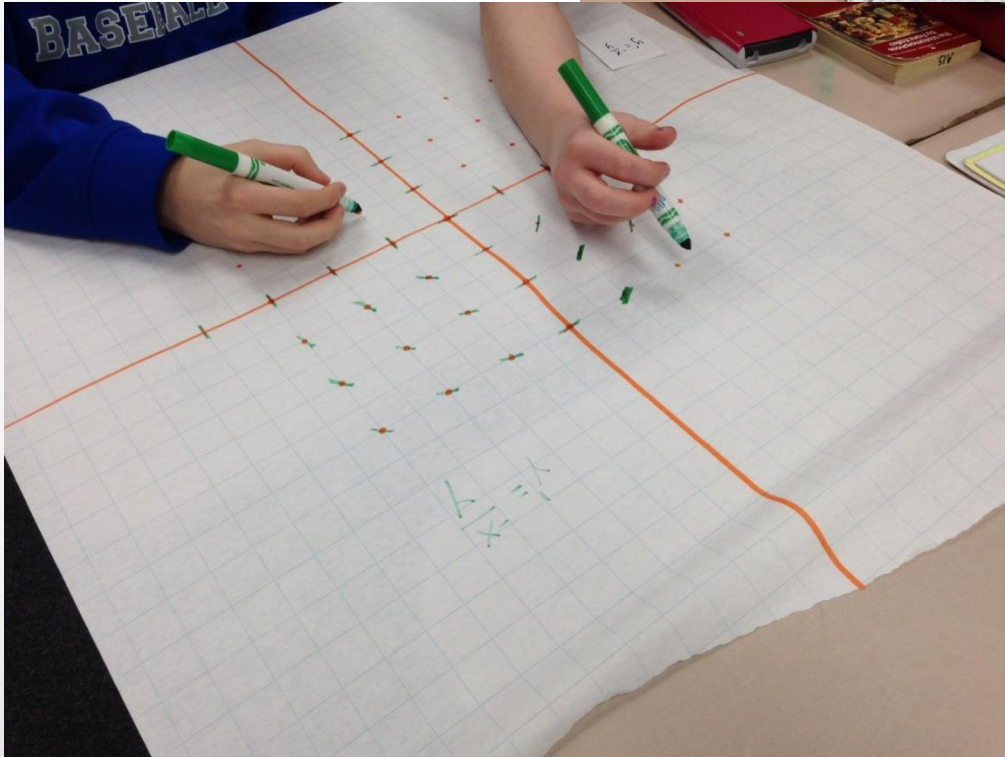
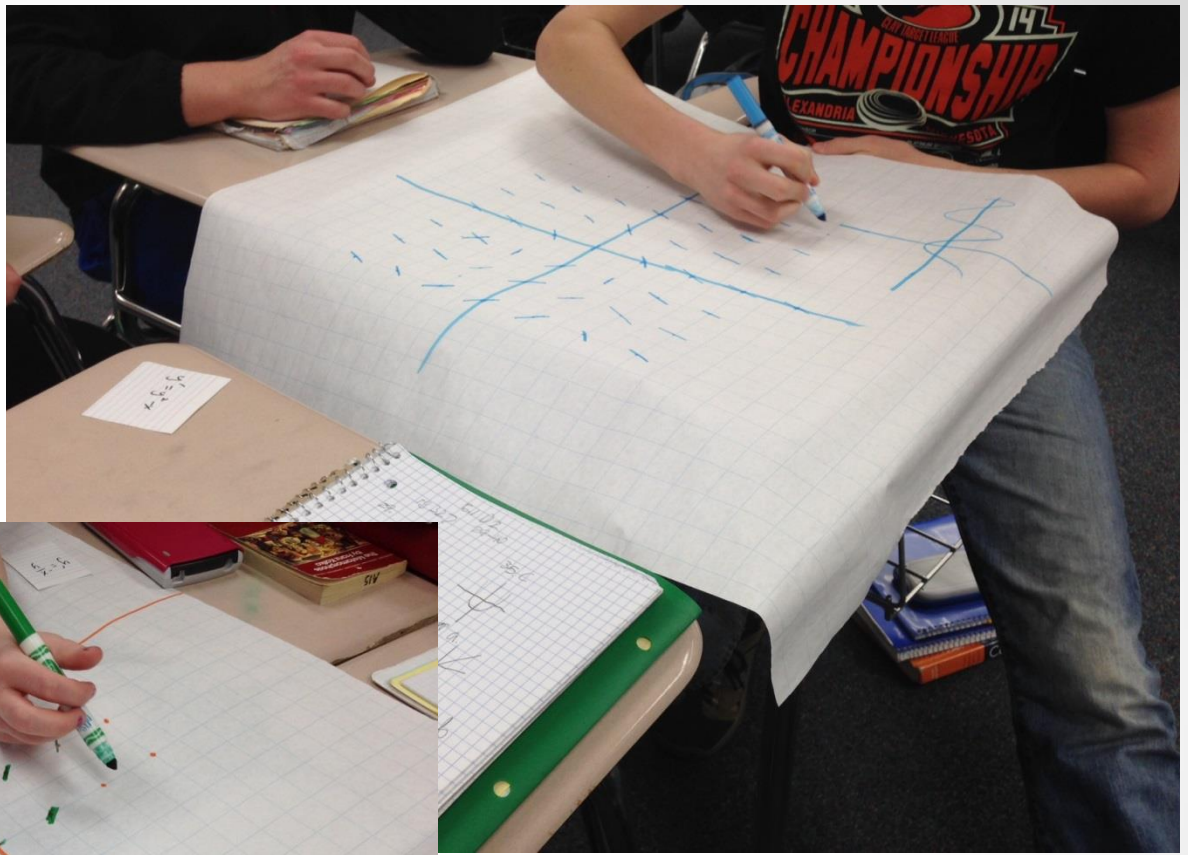
Determining an Algebraic Solution

- Decide if your DE is separable. If it is, solve it using an initial value of $(-2, 1)$
- Technology option: Find an online differential equation solver. Use an initial value of $(-2, 1)$
- Compute the value of $y(0)$ using your solution equation.
- Compare your answer with your slope field results

Slope Field Card Sort

Introduction or Review

- With only graph cards, sort the cards into groups. What is your sorting rule?
- Match the equations and verbal descriptions to your graphs



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AP Curriculum Framework

Enduring

Understandings

(Students will understand that . . .)

EU 3.4: The definite integral of a function over an interval is a mathematical tool with many interpretations and applications involving accumulation.

Learning Objectives

(Students will be able to . . .)

LO 3.4D: Apply definite integrals to problems involving area, volume, **(BC)** and length of a curve.

Essential Knowledge

(Students will know that . . .)

EK 3.4D1: Areas of certain regions in the plane can be calculated with definite integrals. **(BC)** Areas bounded by polar curves can be calculated with definite integrals.

EK 3.4D2: Volumes of solids with known cross sections, including discs and washers, can be calculated with definite integrals.

Honeycomb Volume Activity

Compute the volume of your decoration

- Trace the outline on graph paper
- Measure key points on your outline and record the values in data table(s)
- Compute equation(s) using regression to represent your curves
- Write and compute integrals to determine your decoration's volume
- Check for reasonableness. Compare with another group.

Solid of Revolution

Volume Activity

Compute the volume of your object

- Measure key points on your object and record their values in data table(s)
- Make a graph of your object's outline
- Compute equation(s) using regression to represent your curves
- Write and compute integrals to determine your object's volume
- Use displacement to find the object's actual volume.
- Determine the error in your calculations.

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Using TI Nspire CX CAS

- Open a New Document
- 4: Add Lists & Spreadsheets
 - Enter the data, giving each column a name
- Add a Page 5: Add Data & Statistics
 - Create graph using names for axes labels
 - Find a regression that works well
- Add a Page 1: Add Calculator
 - Repeat Stat Calculation and save as f1
 - Integrate

Mathematical Practices for AP Calculus

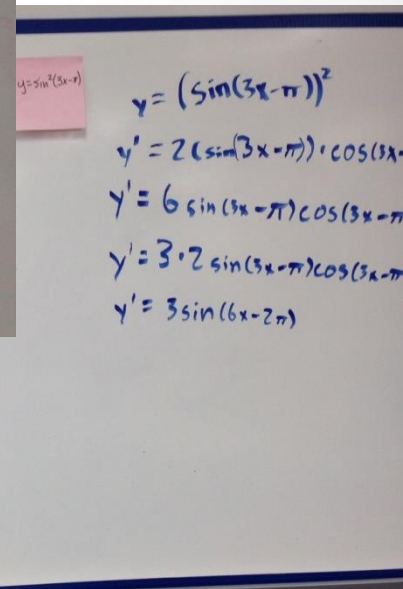
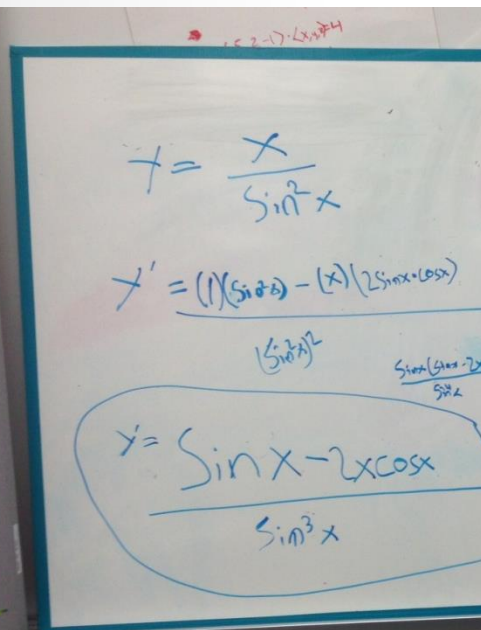
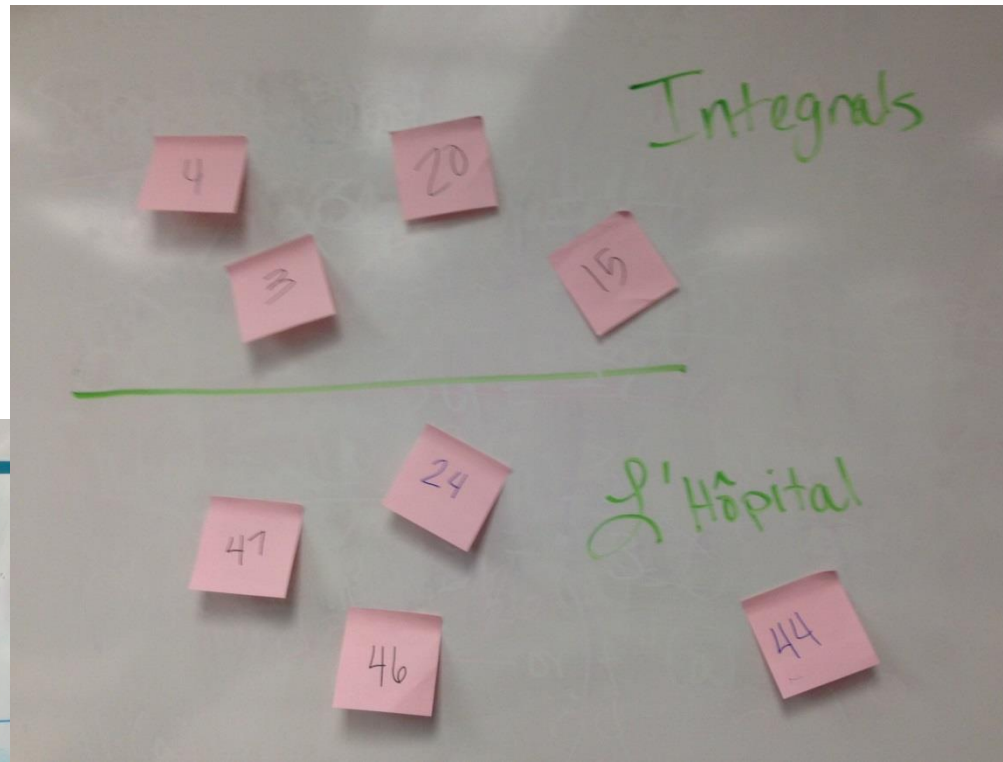
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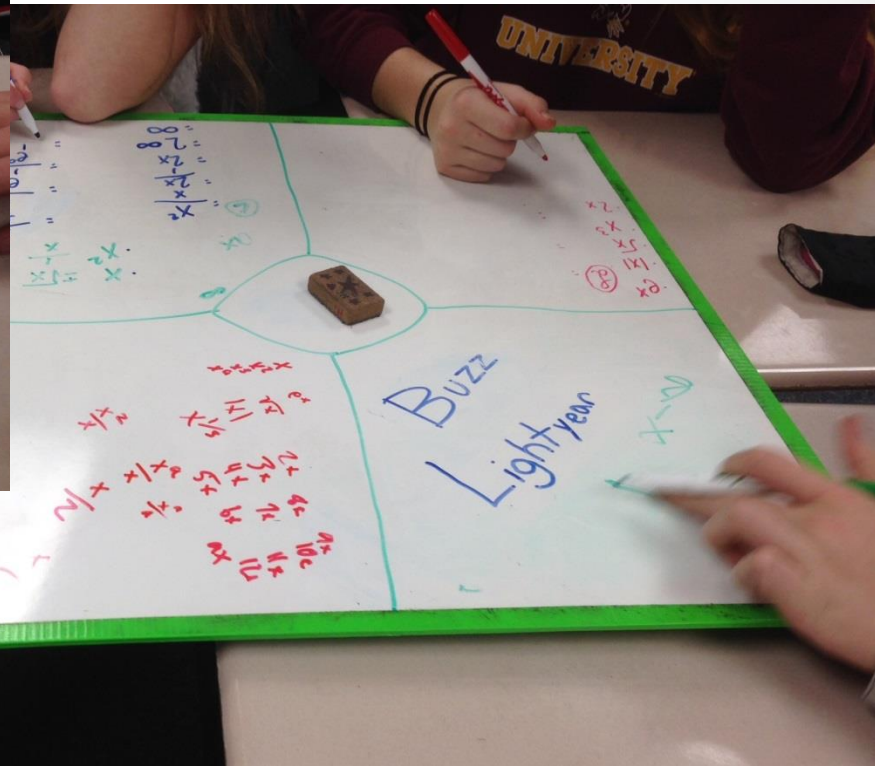
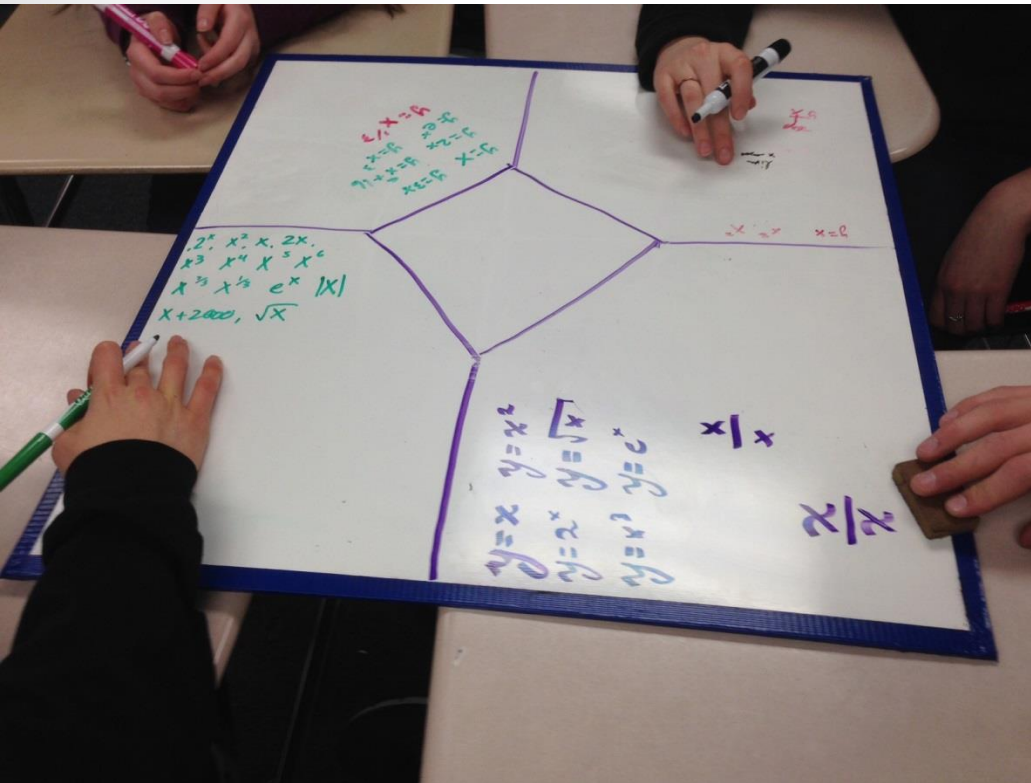
Whiteboarding

Review homework problems



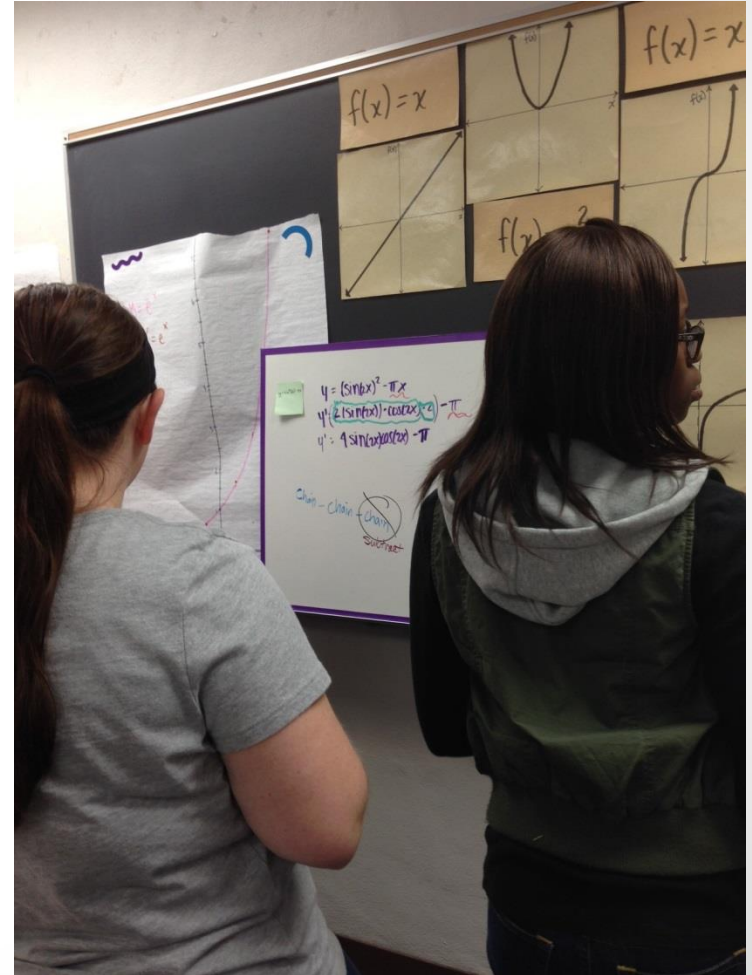
Whiteboarding

Brainstorm and Collaborate



Whiteboarding

Review with Gallery Walk



Whiteboarding

AP Test Review

- Explain how to reach each wrong answer on MC
- Work together on FR

Review Projects

Group Review Project

- Song
- Skit
- Cartoon
- Short Story
- Game

ALL with 3 assessment questions

Review Projects

Individual Review Project

- **Consult an Expert**
 - Summarize your topic
 - Finish 2 statements
 - Work 3-8 homework problems
- **You're the Teacher**
 - Write the Notes
 - Write the Quiz
 - Explain it to a friend
 - Create a calculator program

Use Tic-Tac-Toe Grid for topics

Resources

- AP Teacher Community and EDG
- Designated Deriver
- AP Calculus Wiki
- Facebook Group -- AP Calc Teachers AB/BC
- Stu Schwartz' Master Math Mentor Website
- Sean Bird's Website
- Lin McMullin's Blog
- TMBoS
- **Sign up to be an AP Reader!**

Resources

- Slope Field Card Sorts:
- A) Created by Nancy Stephenson, St. Thomas High School, Houston, TX:
http://apcentral.collegeboard.com/apc/public/repository/ap08_calculus_slopefields_cardmatch.pdf
- B) Created by Debbie Preston, Keystone School, San Antonio, TX:
[https://apcalcwiki.wikispaces.com/file/view/L\)+Binder2+Graphing+PDFS.pdf](https://apcalcwiki.wikispaces.com/file/view/L)+Binder2+Graphing+PDFS.pdf)