Content Collaboration Day: Mathematics

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Amy Lewis

Math Specialist

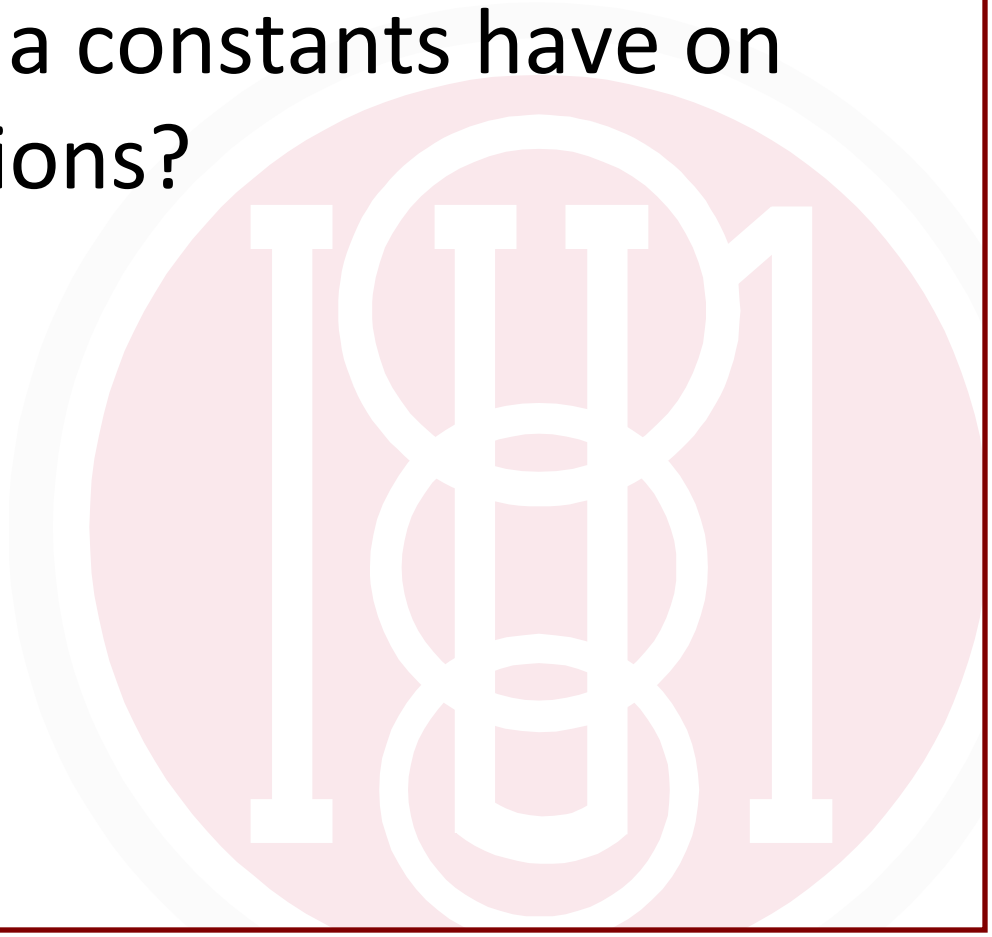
IU1 Center for STEM Education

Using Calculators in the High School Classroom

- Agenda
  - Examples
    - Exploring Transformations
    - Name that Graph!
    - Cabri, Jr.
    - Exploring Derivatives of Trigonometric Functions
  - Rationale for using calculators at this level
  - Resources
  - Q & A

Exploring Transformation

- What effect does a change in a coefficient and/or a constants have on the graph of functions?



Exploring Transformations

- Graph y = x
  This will be your reference line for linear functions. Include its graph in the graphs of each set of functions below.
- Next graph different forms of linear functions.
  Substitute different values for m and b. Use a variety of values including ones that are greater than 1, between 0 and 1, between 0 and -1, and less than -1.

Form 1	Form 2	Form 3
y = mx	y = x + b	y = mx + b

- What effects did the changing coefficients and constants have on the graph of y=x?

Exploring Transformations

- Graph $y = x^2$

  This graph will be your reference graph for quadratic functions. Include its graph in the graphs of each form of functions below.

- Next graph different forms of quadratic functions.

  Substitute different values for a and c. Use a variety of values including ones that are greater than 1, between 0 and 1, between 0 and -1, and less than -1.

Form 1	Form 2	Form 3
$y = ax^2$	$y = x^2 + c$	$y = ax^2 + c$

- What effects did the changing coefficients and constants have on the graph of $y=x^2$?

Exploring Transformations

- Graph $y = x^2$
  This graph will be your reference graph for quadratic functions. Include its graph in the graphs of each set of functions below.
- Next graph different forms of quadratic functions.
  Substitute different values for h and k. Use a variety of values including ones that are greater than 1, between 0 and 1, between 0 and -1, and less than -1.

Form 4	Form 5	Form 6
$y = (x + h)^2$	$y = a(x + h)^2$	$y = a(x + h)^2 + k$

- What effects did the changing coefficients and constants have on the graph of $y=x^2$?

Exploring Transformations

- Graph this set of Quadratic functions:

  $y = x^2$

  $y = x^2 + x - 2$

  $y = 2x^2 - 4x - 6$

  $y = -2x^2 + 8x - 6$

- What effects did the changing coefficients and constants have on the graph of $y=x^2$?

Exploring Transformations

- Graph $y = 2^x$

  This will be your reference graph for exponential functions.

- Next graph different forms of exponential functions.

  Substitute different values for h and k. Use a variety of values including ones that are greater than 1, between 0 and 1, between 0 and -1, and less than -1.

Form 1	Form 2	Form 3
$y = 2^x + k$	$y = -2^x + k$	$y = 2^{(x+h)} - k$

- What effects did the changing coefficients and constants have on the graph of $y=2^x$?

Exploring Transformations

- What mathematics is involved in this task?
- What is the value of this task?
- When should it be used?

Name that Graph!

Objective: To write an equation that describes a mystery graph.

Materials: Graphing calculator for each player, Name That Graph recording sheets

Directions: Player 1 creates a mystery graph by entering a linear, quadratic or exponential equation into his or her calculator. (Be sure to clear the Y= list before each round.) Equations may have any of the forms we investigated. Select coefficients and constants from the following list:

0.1, ¼, ½, 1, 2, 3, 4, 5, 10,

- 0.1, -¼, -½, -1, -2, -3, -4, -5, -10

Name that Graph!

- Player 1 displays the ***graph*** of the function (NOT the actual equation) in the standard viewing window. This is the mystery graph.
- Player 2 then tries to find the equation that produced the mystery graph.
- Player 2 writes the predicted equation on the recording sheet.

Name that Graph!

- Player 1 graphs the predicted equation on his or her calculator and displays it along with the mystery graph.
- (Player 2 also may graph the predicted equation on his or her own calculator to check that Player 1 entered the equation correctly.)
- Be sure to use the same viewing window on both calculators.

Name that Graph!

- Player 2 compares the graph of the predicted equation to the mystery graph. (Player 2 may ask Player 1 to change the viewing window to better compare the graphs.)
- If the graphs don't match, Player 2 revises his or her equation to get a better fit.
- Player 1 then displays the graph of the new predicted equation along with the mystery graph.

Name that Graph!

Player 2 continues to revise the predicted equation and compare graphs until he or she believes that the predicted equation is the equation of the mystery graph. At that point, Player 1 reveals the equation of the mystery graph. Player 2 receives 5 points if the final equation is correct and loses 1 point for each incorrect prediction equation.

Name that Graph!

- Players then reverse roles: Player 1 tries to find the equation of the mystery graph that Player 2 creates.
- Play continues until each player has tried to find equations for 3 mystery graphs, or until time runs out.
- The winner is the player with the highest total score.

Name that Graph!

Have fun!

Don’t forget the list of acceptable coefficients and constants:

0.1, ¼, ½, 1, 2, 3, 4, 5, 10,

- 0.1, -¼, -½, -1, -2, -3, -4, -5, -10

Name that Graph!

- What mathematics is involved in this task?
- What is the value of this task?
- When should it be used?

Cabri, Jr.

- All TI-83+ and TI-84 calculators have been loaded with a program called Cabri, Jr.
  - Go to APPS
  - 2: CarbiJr
- Similar to Geometer's Sketchpad, but a "mini-version" for the calculator.
- Let's prove that a central angle is twice the inscribed angle from the same arc.

Cabri, Jr.

- Draw a circle of any size on your screen.
  - [F2] gets you the drawing menu
  - Scroll down to **Circle**
- Draw 2 segments to create a central angle.
- Draw 2 segments to create an inscribed angle with the same endpoints.
- Measure the two angles.
- Grab an endpoint and move the circle around to see if the relationship is constant.

Cabri, Jr.

- What mathematics is involved in this task?
- What is the value of this task?
- When should it be used?
- What else can you do with Cabri, Jr.?

Exploring Derivatives

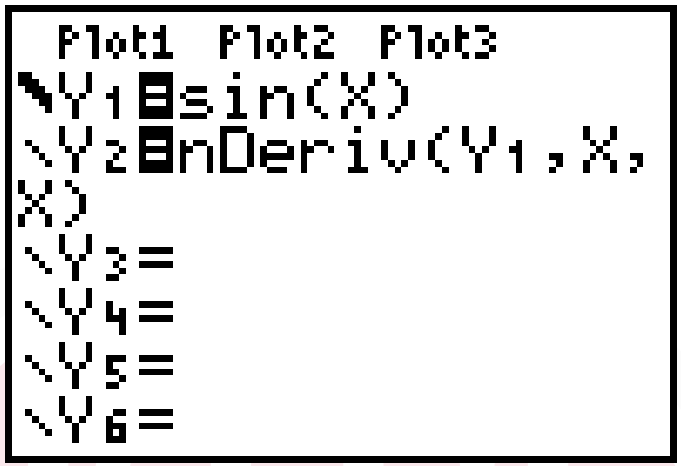
Graph the function $y = \sin x$ and its derivative.

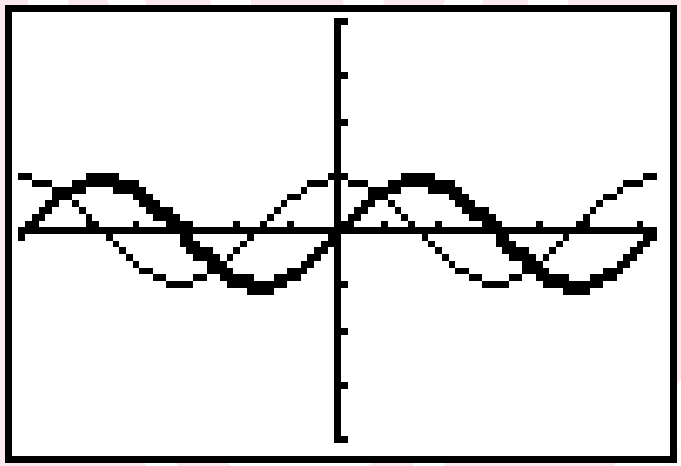
Examine the graph of the derivative and determine how it relates to the graph of the function.

Notice the values of the derivative when the function is increasing and when it is decreasing.

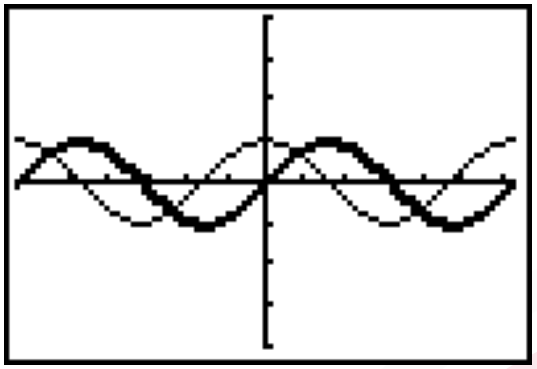
Exploring Derivatives

- Make sure your calculator is in radian mode.
- Enter Y1 = sin(X) and Y2 = nDeriv(Y1,X,X).
- Change the graphing style of Y1 to "thick.“
- Display both graphs in an appropriate viewing window.





Exploring Derivatives



- When the graph of $y = \sin x$ is increasing, what is true about its derivative? When the graph of $y = \sin x$ is decreasing, what is true about its derivative?
- What is the value of the derivative when $y = \sin x$ has a turning point?
- Make a conjecture about what function the derivative of $y = \sin x$ might be. Enter the function you conjectured into Y3 and determine if the graphs defined in Y2 and Y3 coincide.

Exploring Derivatives

- Follow the same process for:
  - sin 2x
  - cos kx
  - e^x
  - e^{kx}

http://education.ti.com/html/t3_free_courses/calculus84_online/mod12/mod12_lesson1.html

Exploring Derivatives

- What mathematics is involved in this task?
- What is the value of this task?
- When should it be used?

“It’s nothing but a crutch!”

- How can the use of calculators *assist* students in thinking more deeply about mathematics at the middle school level?
- What are some potential pitfalls?
- What do teachers need to do to avoid these pitfalls?

Resources

- Texas Instruments: Classroom Activities

http://education.ti.com/educationportal/sites/US/sectionHome/classroomactivities.html

- Texas Instruments: Free Online Courses

http://education.ti.com/educationportal/sites/US/sectionHome/pd_onlinecourses_free.html

- National Library of Virtual Manipulatives

http://nlvm.usu.edu/en/nav/vLibrary.html

Q & A

Thanks!

Amy Lewis

alewis@washjeff.edu

(724) 250-3330

Materials can be found at

http://makingsenseofmath.iu1.wikispaces.net