

Precalculus Enhanced with TI Navigator

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Conceptual Understanding of the Connection between an Equation and its Graph

Once students are in the Activity Center, have them move their cursor to, say, Quadrant II.

(Use a standard window setting.)

Then have them move so that their x -coordinate is 3 (and their y -coordinate to be anything they want).

Ask, what equation is this? /

Have them move so that their y -coordinate is 3 (and their x -coordinate to be anything they want).

What equation is this?

Adjust Y_{min} and Y_{max} . ($Y_{max} = 25$, $Y_{min} = -25$). Ask them to spread out their x -values and make their y -value to be twice the x -value plus 3 more. Once all are in position, click on the Graph-Equation tab and overlay the line $y = 2x + 3$.

Navigator Set Up

Open Activity Center on your computer and set up the activity to Contribute Points. Then click on Configure, setting Number of points per students (5), Step size (1), and check the boxes

Display coordinates, Let students resubmit points, and Send current graph contents as background.

Rental Car Activity

Distribute the problem below, one to each student, where d is 1, 2, ..., up to 24:

Three rental car companies are shown. The cost in dollars of renting a car from three different rental agencies and driving it d days is given by the following:

$$C_1 = 9d$$

$$C_2 = 30 + 3d$$

$$C_3 = 72$$

Which graph represents the cheapest agency if you drive $d = 1$ day?

Move your cursor to the point on this graph. Mark.

Use Activity Center to display the three graphs. Ask students to identify which graph corresponds to which agency, and how do they know.

Once they move their cursor to the line which is the cheapest for their individual situation, ask them to work in groups to determine the conditions for which each Agency is the cheapest.

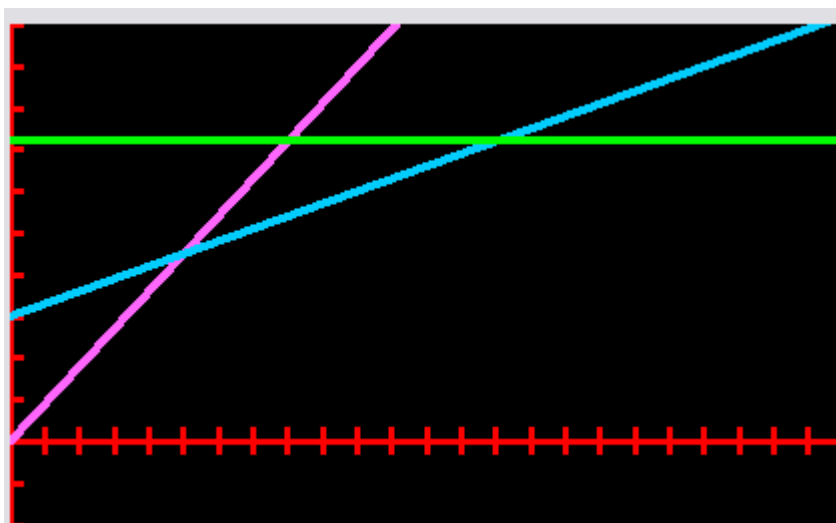
Navigator Set Up

Contribute

Points

Configure:

Send current graph contents as a background



$$0 \leq x \leq 24 \text{ by } 0 \leq y \leq 100$$

$$X_{scl} = 1, Y_{xsc} = 10$$

Domain and Range Activity

Use Activity Center to display a graph such as the one shown.

Each grid is a 1 unit by 1 unit.

Ask students to move their cursor to a unique point on the graph, trying to cover as much of the graph as possible.

To visualize the set of points which are in the domain, students march to the x -axis, keeping the x -coordinate the same.



Similarly, students show the set of points which are in the range after returning to their original positions.

Navigator Set Up

1. Prior to the activity in a separate file such as Notepad, store the equation $-1.93(x-4) * \text{sqrt}(1 - (-.5(x-4) - 1)^2)$ to copy and paste into the Y= box later.
2. Open Activity Center. If necessary, click on **Edit > Clear Activity Data** and click on Yes to confirm. Click on **Edit > Edit Window Settings** to make a viewing window $-1 \leq x \leq 7$ by $-1 \leq y \leq 6$ with $Xscl = Yscl = 1$. Check the boxes **Grid**, **Coords**, and **Axes**.
3. Click on the **Graph-Equation** tab. Copy and paste the equation in Step 1 into the Y= box and click on Add.
4. On Contribute Points: Click on Configure, choose the number of points per student (1), Step Size (0.1), and check the boxes **Display coordinates** and **Send current graph contents as background**.
5. Click on **View > Individualize Student Cursors**. Click on Start Activity.

Solving Equations by Completing the Square

Optional: Prior to activity, force send to students the (unarchived) program **ALPATIO.8XP** and the Cellsheet AppVars **SQR.8XV** and **SQR2.8XV**, and the Learning Check **compsquare.edc**

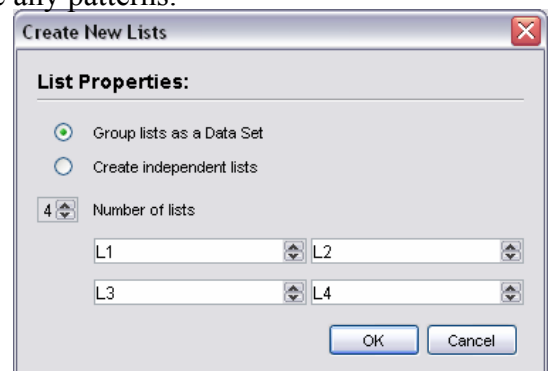
1. Review foundational concepts: Students (or the teacher) runs the program ALPATIO to see an application which requires solving an equation of the form $(x+3)^2 = 26$. Ask students to get into Activity Center. Send a QuickPoll, with open response, asking for the exact answer to the solution. Click on the Poll Details tab to get the numerical expressions. (Perhaps discuss “exact” vs. “approximate” and the limits of machines.)
2. While still in Activity Center, students generate and share several perfect square trinomials (putting their coefficients in L1, L2, L3) and we then try to observe any patterns.

Click on Contribute Lists:

Group lists as a Data Set

Number of lists: 4 (L1, L2, L3, L4)

Click OK



Configure:

Main Settings:

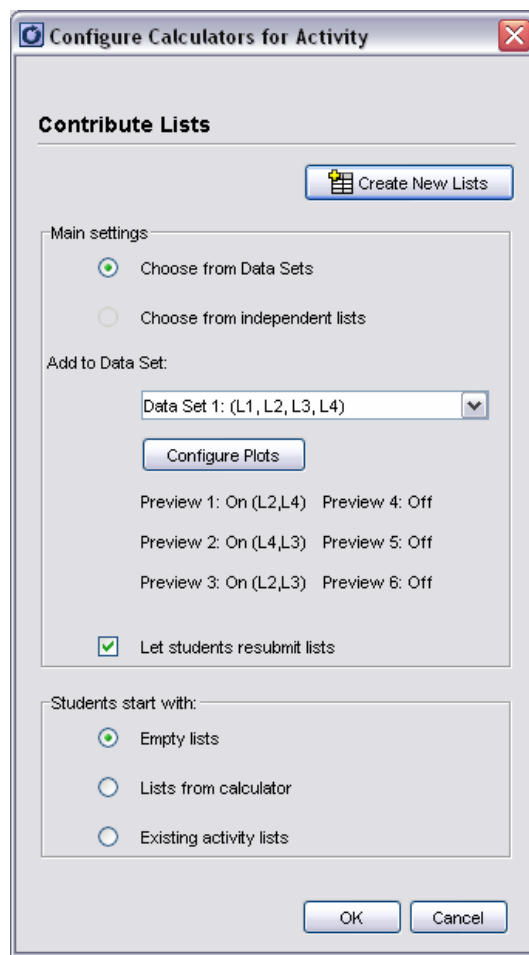
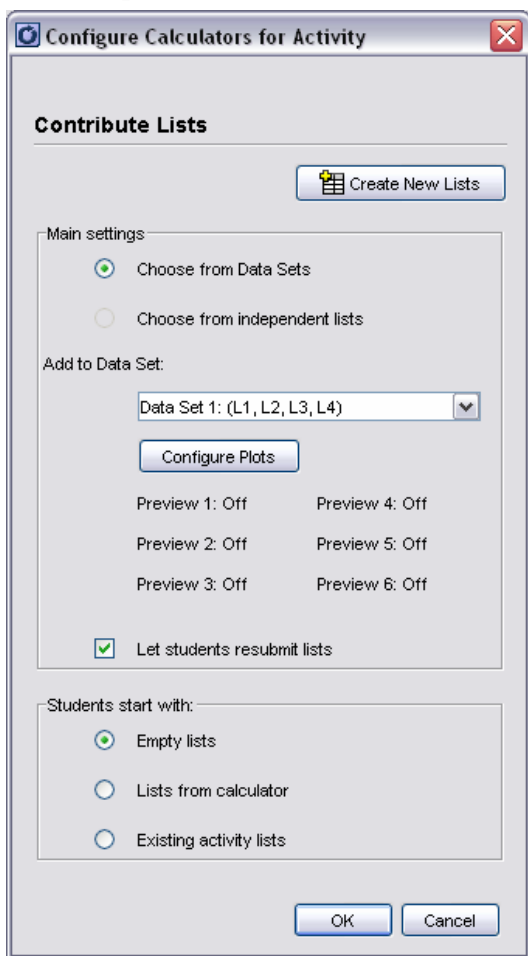
Choose from Data Sets

Students start with:

Empty lists

Optional:

For a graphical connection,
configure plots as follows:

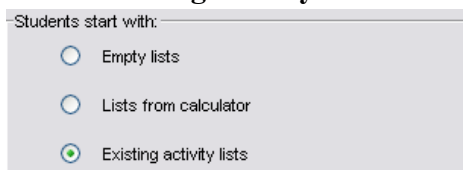


- Students make up some nonzero random numbers h in L4 (or you can assign these) and then expand $(x + h)^2 = ax^2 + bx + c$. They insert a , b , and c in L1, L2, and L3, respectively. (Of course, $a=1$) Click on the List tab. (If in Step 2 you took the option of enabling them to preview plots, students can check to see if a visual pattern emerges.

- Click on the List tab to see the lists.

We want to find the pattern which relates L2, L3 and L4. Since it may be easier for them to see this on their handheld, stop the activity and send it to them. Click on Configure:

Select Existing activity lists



Contribute: Lists | Configure | Start Activity | Pause Activity | Stop Activity | Quick Poll

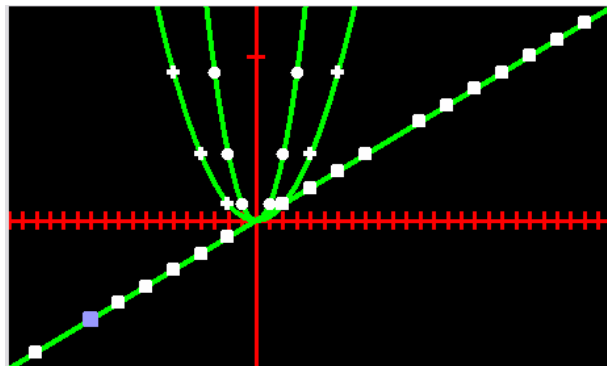
List | List - Graph | Graph | Graph - Equation | Equation

Create New Lists

Data Set 1: (L1, L2, L3, L4)

Add	L1	L2	L3	L4
Display Name	L1	L2	L3	L4
<Hidden>		1	2	1
<Hidden>		1	18	81
<Hidden>		1	4	4
<Hidden>		1	-10	25
<Hidden>		1	14	49
<Hidden>		1	-16	64
<Hidden>		1	-2	1
<Hidden>		1	-4	4
<Hidden>		1	-6	9

Click on OK and start the activity again so they can see the aggregation of the entire class data. Plots can be constructed on the teacher's console or the student's calculator, if you configured them as in the option in Step 2.



Ask students, how are columns 2 and 4 related? In other words, if they are given L2, then how do they get L4? (L4 is half of L2)

Ask, how are columns 3 and 4 related? (L3 is the square of L4)

Ask, if given L2, how do you get the number in L3? (Take half of it and square it.)

Have them complete the blanks in general for a perfect square trinomial: $x^2 + kx + \underline{\hspace{1cm}} = (x + \underline{\hspace{1cm}})^2$
Exit Navigator.

5. Optional: Run the Cellsheet App and open the spreadsheet SQR you sent them prior to the activity.

(Use the **Menu** soft key and File > Open)

Students type in values in cell B5.

Ask students to pay attention to (and then predict) the coefficients of the middle and last term of the trinomial.

Caution: There is no "Undo" in Cellsheet.

SQR	A	B	C
1	X ² +		
2	-10X+		
3		25	
4			
5	=(X+	-5)) ²
6	CHANGE CELL	B5	
B5: -5			[Menu]

SQR	A	B	C
1	X ² +		
2	-3.6X+		
3		3.24	
4			
5	=(X+	-1.8)) ²
6	CHANGE CELL	B5	
B5: -1.8			[Menu]

In typical problems, students must write a perfect square trinomial given $x^2 + kx$

In Cellsheet, have them open the spreadsheet SQR2 which you sent them. This is a two player game.

SQR2	A	B	C
1	PLYR1	CHANGE	A4.
2	PLYR2	CHANGE	B5,B6
3	X ² +		1
4		B X+	
5		16	
6	=(X+	4)) ²
A4: 100			

Cell C3 displays a 1 if the trinomial is equal to the square of the binomial, 0 otherwise.

As shown on the screen, Player 1 types a value for Cell A4. In this case, 100.

SQR2	A	B	C
1	PLYR1	CHANGE	A4.
2	PLYR2	CHANGE	B5,B6
3	X ² +		1
4		B X+	
5		16	
6	=(X+	4)) ²
A4: 100			

SQR2	A	B	C
1	PLYR1	CHANGE	A4.
2	PLYR2	CHANGE	B5,B6
3	X ² +		0
4		100 X+	
5		16	
6	=(X+	4)) ²
E4: "X+			[Menu]

Notice Cell C3 is 0 after the ENTER button is pressed.

Player 2 now must type the correct values for both Cells B5 and B6 to earn a point.

SQR2	A	B	C
1	PLYR1	CHANGE	A4.
2	PLYR2	CHANGE	B5,B6
3	X2+		0
4	100 X+		
5		250	
6	=(X+	50)²	
A4: 100			[Menu]

If Player 2 is incorrect, then Player 1 may take a turn to get Player 2's point.

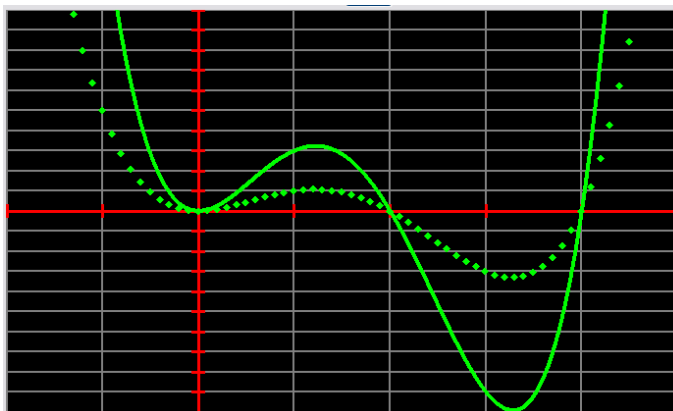
SQR2	A	B	C	SQR2	A	B	C
1	PLYR1	CHANGE	A4.	1	PLYR1	CHANGE	A4.
2	PLYR2	CHANGE	B5,B6	2	PLYR2	CHANGE	B5,B6
3	X2+		0	3	X2+		1
4	100 X+			4	100 X+		
5				5		2500	
6	=(X+	50)²		6	=(X+	50)²	
B5: 50²				C5:			[Menu]

At the end of the round, players switch roles and the game continues for a few more rounds.

- Summative Assessment: Have students due complete the learning check document compsquare.edc In NavNet, students got to Network Apps, then to LearnChk. Discuss results with a slide show through Class Analysis.

Stretch/Compress the Function

In a viewing window $-2 \leq x \leq 5$ by $-10 \leq y \leq 10$ display the equation $y = x^2(x-2)(x-4)$ and a plot of a transformation. Contribute equations, with students given $y = x^2(x-2)(x-4)$ and ask them to modify this and send you the transformed function. If needed, you might point out the desired function passes through $(1, 1)$, and its parent passes through $(1, 3)$.



Water Fountain Activity

The graph of two parabolas shown arises in the design of a water fountain.

Produce such graphs on your calculator.

There are many possible answers.

Set your window domain to $0 \leq x \leq w$.

Set your window range to $0 \leq y \leq h$.

Report the equations of your parabolas.

Ask students to show the Y= menu and perform a screen capture. What is the general pattern? Suppose instead of $\frac{1}{2}$ it were $\frac{1}{3}$? $\frac{1}{4}$?

