

## Building Curves

ID: 8962

Time required  
45 minutes

## Activity Overview

*In this activity, students approach performing the four basic operations—addition, subtraction, multiplication and division—on polynomials from a graphical perspective. Given the graphs of two functions, they plot points that lie on the graph of the sum of the functions and draw conclusions about its behavior. Next, they calculate a regression, using what they know about the degree of the polynomials they are adding, to fit the points they plotted. Finally, they find the sum of the functions algebraically and compare it with the result of the regression. Similar explorations are then performed for the difference, product, and quotient of polynomials.*

Topic: Polynomials &amp; Polynomial Equations

- *Add, subtract, multiply, and divide any pair of polynomials in one variable.*
- *Graph a polynomial of any degree.*
- *Use a polynomial function to model data.*

## Teacher Preparation and Notes

- *This activity is designed to be used in an Algebra 2 or Precalculus classroom.*
- *Prior to beginning this activity, students should have been introduced to basic polynomial (linear, quadratic, cubic, and quartic) functions, their graphs, and the concept of degree of a polynomial.*
- *If time considerations require, Problems 1 and 2 can be performed in class and Problems 3 and 4 assigned as homework.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student .tns file, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter “8962” in the keyword search box.***

## Associated Materials

- *BuildingCurves\_Student.doc*
- *BuildingCurves.tns*

## Suggested Related Activities

*To download any activity listed, go to [education.ti.com/exchange](http://education.ti.com/exchange) and enter the number in the keyword search box.*

- *Polynomial Addition and Subtraction (TI-Nspire Technology) — 11492*
- *Polynomial Addition, Subtraction (TI-84 Plus family) — 1574*
- *Multiplying Polynomials (TI-Nspire Technology) — 9682*
- *Polynomial Operations (TI-Nspire Technology) — 8410*

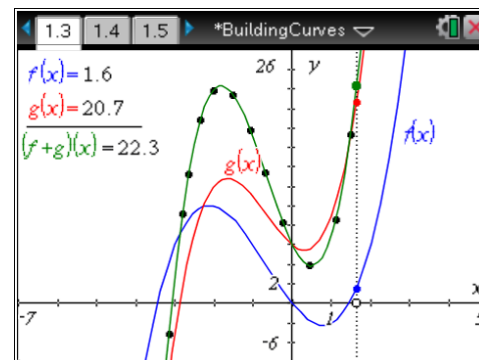
**Problem 1 – Adding Polynomials**

In this problem, students build the graph of  $(f + g)(x)$  from the graphs of  $f(x)$  and  $g(x)$ . Before moving past the introduction on page 1.2, discuss what  $(f + g)(x)$  means and make hypotheses about what the graph of  $(f + g)(x)$  will look like. Ask: *If  $f(x) = 2$  and  $g(x) = 3$ , what will  $(f + g)(x)$  look like?*

Students should find that, for the graph of  $(f + g)(x)$ , each y-value is simply the sum of  $f(x)$  and  $g(x)$ . Page 1.3 shows the graphs of  $f(x)$  and  $g(x)$  as well as a plotted point that is  $(f + g)(x)$ . Students move the slider on the x-axis to choose an x-value, and the values of  $f(x)$ ,  $g(x)$  and  $(f + g)(x)$  update as well as their plotted points.

Page 1.4 prompts students to mark at least 10 points on the curve  $(f + g)(x)$ . The data capture has been set up for them on page 1.6, so students need only move the points and press **ctrl** + **.** to capture a point.

Once the students have marked their points, discuss the shape they form. Ask: *What type of polynomial graph do the points appear to form?*



**TI-Nspire Navigator Opportunity: Live Presenter**

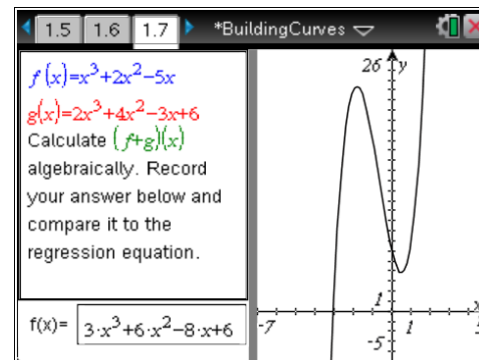
**See Note 1 at the end of this lesson.**

Students view the data they collected, similar to a table of values for the function  $(f + g)(x)$ , on page 1.6. They then calculate a regression equation to fit the points they marked. Students must choose a type of regression based on what they know about the degree of  $f + g$ . (To calculate the regression, students will select Columns A and B, go to **MENU > Statistics > Stat Calculations...**, and select the type of regression they wish to perform.)

es	B	yvalues	C	D	E
1	5094	-3.07368	Title	Cubic R...	
2	1132	9.25369	RegEqn	$a \cdot x^3 + b \cdot x^2 + c \cdot x + d$	
3	5038	13.2613	a	3.	
4	5849	18.8856	b	6.	
5	1887	21.9202	c	-8.	

D2 = "a\*x^3+b\*x^2+c\*x+d"

On page 1.7, students are given the equations for  $f(x)$  and  $g(x)$ . They are directed to find  $(f + g)(x)$  algebraically and compare the results with the regression equation they found. If the regression equation and the equation they found algebraically match, it confirms that they built the curve correctly.

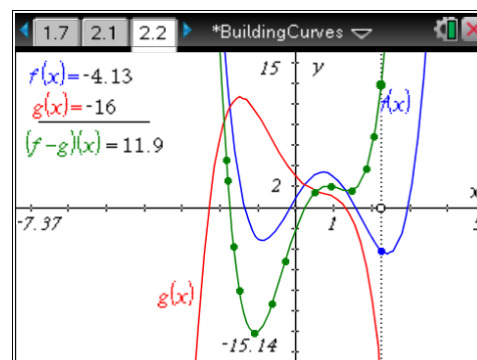


**TI-Nspire Navigator Opportunity: Quick Poll**

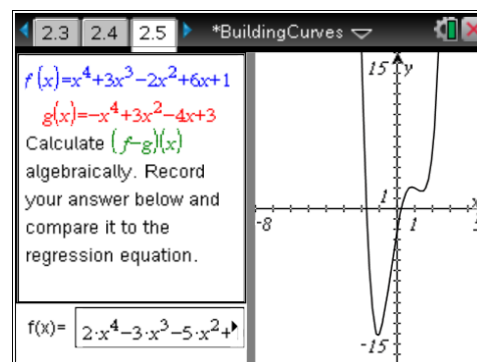
See Note 2 at the end of this lesson.

**Problem 2 – Subtracting Polynomials**

In this problem, students use the same process they used in Problem 1 to subtract polynomials. Students should be able to complete this problem independently, but it is still important to discuss the degree of the resulting equation and the shape of the resulting graph as a class.



Students will use a Quartic Regression. The resulting equation should be  $(f - g)(x) = 2x^4 - 3x^3 - 5x^2 + 10x - 2$ .

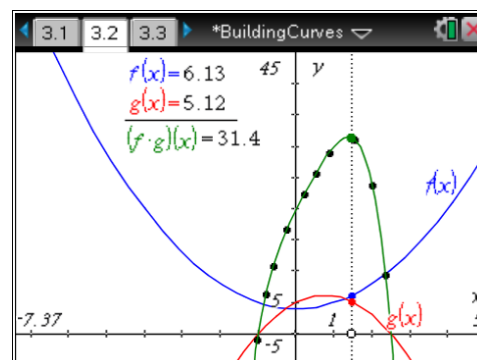


**TI-Nspire Navigator Opportunity: Quick Poll**

See Note 3 at the end of this lesson.

**Problem 3 – Multiplying Polynomials**

Students will use a Quartic Regression. The resulting equation should be  $(f \cdot g)(x) = -2x^4 + 3x^3 - 3x^2 + 12x + 20$

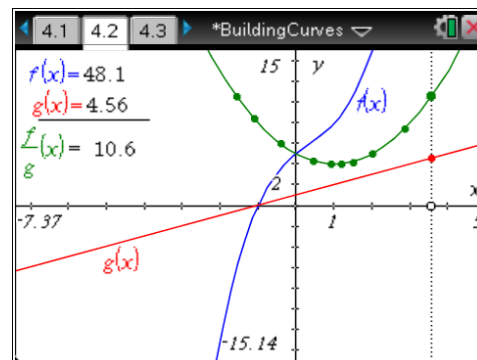


**TI-Nspire Navigator Opportunity: Quick Poll**

See Note 4 at the end of this lesson.

**Problem 4 – Dividing Polynomials**

Students will use a Quadratic Regression. The resulting equation should be  $(f \div g)(x) = x^2 - 2x + 5$

**TI-Nspire Navigator Opportunities****Note 1****Problem 1, Live Presenter**

It may be helpful to students if *Live Presenter* is used to discuss the interactivity of this page as well as how to go about plotting the values of  $(f + g)(x)$ .

**Note 2****Problem 1, Quick Poll,**

Instead of having the students enter their function for  $(f + g)(x)$  on page 1.7, try instead to send them a *Quick Poll* using page 1.7 from the .tns file on the teacher computer. Also, set the results display to graphical instead of tabular. In this way, each student's graph is plotted and they can see that they are all APPEAR to be the same. Then change the results settings to tabular and notice how all the equations are NOT all the same. Have a discussion with the students as to why that occurred.

You might also consider sending *Quick Polls* for the other student responses for problem 1.

**Note 3****Problem 2, Quick Poll,**

Instead of having the students enter their function for  $(f - g)(x)$  on page 2.5, try instead to send them a *Quick Poll* using page 2.5 from the .tns file on the teacher computer. Also, set the results display to graphical instead of tabular. In this way, each student's graph is plotted and they can see that they are all APPEAR to be the same. Then change the results settings to tabular and notice how all the equations are NOT all the same. Have a discussion with the students as to why that occurred.

You might also consider sending *Quick Polls* for the other student responses for problem 2.

**Note 4****Problem 3, Quick Poll,**

Instead of having the students enter their function for  $(f \cdot g)(x)$  on page 3.4, try instead to send them a *Quick Poll* using page 3.4 from the tns file on the teacher computer. Also, set the results display to graphical instead of tabular. In this way, each student's graph is plotted and they can see that they are all APPEAR to be the same. Then change the results settings to tabular and notice how all the equations are NOT all the same. Have a discussion with the students as to why that occurred.

You might also consider sending *Quick Polls* for the other student responses for problem 3

**Note 5****Problem 4, Quick Poll,**

Instead of having the students enter their function for  $(f \div g)(x)$  on page 4.4, try instead to send them a *Quick Poll* using page 1.7 from the tns file on the teacher computer. Also, set the results display to graphical instead of tabular. In this way, each student's graph is plotted and they can see that they are all APPEAR to be the same. Then change the results settings to tabular and notice how all the equations are NOT all the same. Have a discussion with the students as to why that occurred.

You might also consider sending *Quick Polls* for the other student responses for problem 4