

COMPOSITIONS OF FUNCTIONS ON THE TI-84 AND TI-NSPIRE

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LEARNING OBJECTIVES

- Express a composition of functions as a single function.
- Observe special cases and properties of compositions of functions.
- Apply appropriate technology to graph compositions of functions.
- Evaluate compositions of functions for specified values, with and without technology.

FEED THE NEED

Consider a department store that sends multiple coupons to persons in the same household. One coupon allows \$10 off any purchase and the other allows 20% off a purchase. *Does it matter which order the cashier enters these coupons when completing the transaction?*

EXAMPLES

Complete the table below to identify some scenarios of using the coupons described.

<i>Scenario</i>	<i>\$50 Purchase</i>	<i>\$100 Purchase</i>
\$10 off, then 20% off		
20% off, then \$10 off		
Consecutive \$10 off		
Consecutive 20% off		

Is there any *one* scenario that will always produce the best deal?

Describe an equation to describe the total price after each coupon has been applied to an $\$x$ regular-priced purchase.

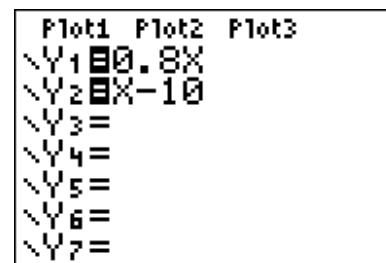
20% off coupon:

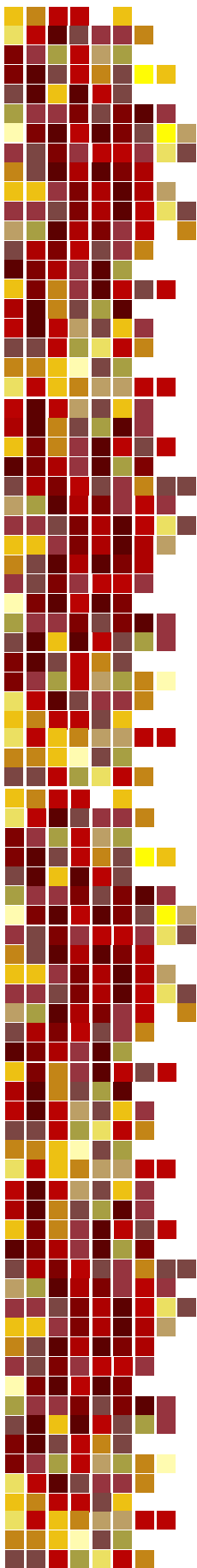
\$10 off coupon:

MODELING THE SCENARIOS

USING THE TI-84 (WITH OS 2.55MP UPDATE):

- Identify functions to enter in Y1 and Y2.
 - Use the functions we identified above.
 - Notice the functions on my screen are not selected (next screenshot), because we are not concerned with the effect of using ONE coupon.





2. Identify the composition of functions that uses each coupon in a different order.
 - a. We can do this similarly using the “Define” command on the TI-Nspire.
3. From a table of values, we can see the difference in *final price* for both coupon scenarios.
 - a. Y3 applies the \$10 coupon first
 - b. Y4 applies the 20% coupon first
4. We note that using the 20% coupon first results in a better deal, but why?

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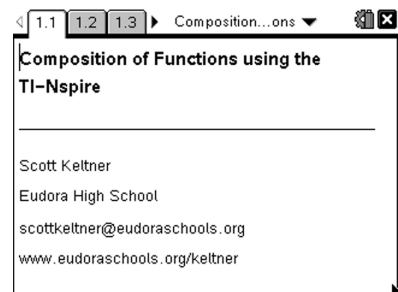
Plot1 Plot2 Plot3
Y1=0.8X
Y2=X-10
Y3=Y1(Y2(X))
Y4=Y2(Y1(X))
Y5=
Y6=
Y7=
  
```

X	Y3	Y4
50	32	30
55	36	34
60	40	38
65	44	42
70	48	46
75	52	50
80	56	54

Press + for Δ |b|

USING THE TI-NSPIRE:

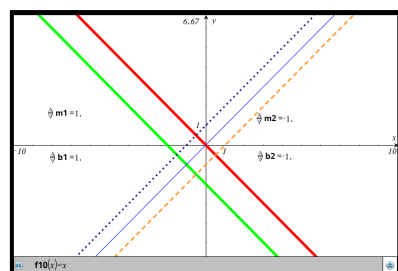
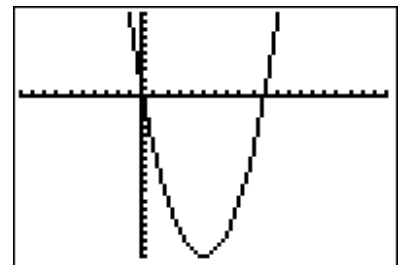
1. Go to www.eudoraschools.org/keltner to download the CompositionOfFunctions.tns file. It is also available using a *PublishView* add-on to your browser.
 - a. When running this file on a computer, it may be more distinct to use the Computer option from the View menu.
 - b. Page 1.5 allows you to see the different composition scenarios (including $f(f(x))$, $f(g(x))$, $g(f(x))$, and $g(g(x))$)by dragging a Slider across the graph.
 - c. Do any of the graphs look the same?
2. Continue the rest of the activity at your own pace, if you choose to.



Want to try more with the TI-Nspire?
 Attend Mike Koehler's or Pat Flynn's session(s) here at the Math Summit.

POSSIBLE EXTENSIONS

- Using the handheld to show that $f(x) \cdot g(x)$ is rarely equivalent to $f(g(x))$ by graphing the expressions simultaneously on the same screen.
- Using the handheld to show that $f(f(x))$ is very rarely equal to $(f(x))^2$.
- Emphasize the fact that $f(g(x))$ is not merely the product of the individual functions $f(x)$ and $g(x)$.
- Have students try to manually create inverse functions by analyzing their composition rather than the functions (this was done on the CompositionOfFunctions.tns file).



THE HAPPY ENDING

When you have multiple coupons to use at a store, one for a dollar-discount and another for percent markdown, which coupon do you present to the cashier first?