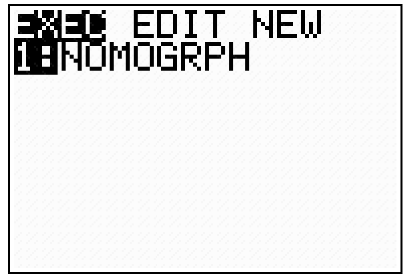
# Advanced Algebra Nomograph

*NOMOGRPH.8xp*

**Name** ______________________

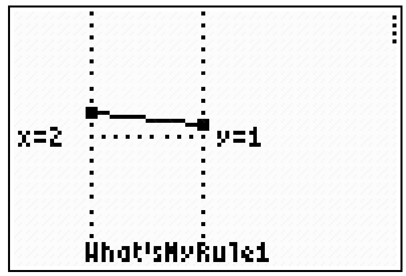
**Class** ______________________

Listen as your teacher explains how the model of the nomograph works. Then open the **NOMOGRPH** program on your calculator and work with a partner to complete the activity.




**Problem 1 – "What's my Rule?"**

Select **1:What'sMyRule** and then choose **1:What'sMyRule1**.




Enter a value of $x$. The nomograph relates it to a $y$-value by substituting the value of $x$ into the function's rule.

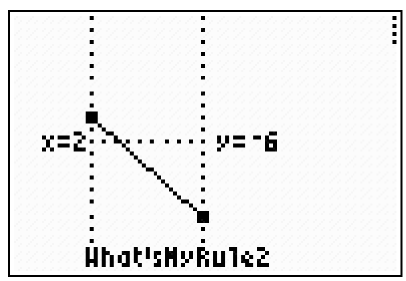
Find the "mystery rule" for $f(x)$ that pairs each value for $x$ with a value for $f(x)$.

$f(x)$ = ___________

When you are finished, enter the value **86** to return to the menu.

**Problem 2 – A more difficult "What's my Rule?"**

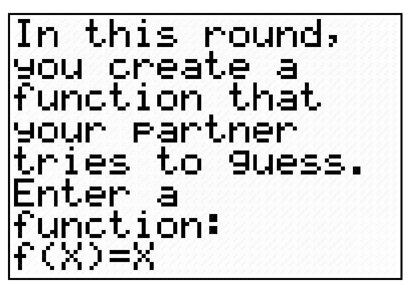
The second nomograph (**1:What'sMyRule > 2:What'sMyRule2**) follows a non-linear function rule. As before, enter values for $x$ and find the rule for this new function $f(x)$. Test your rule using the nomograph.




$f(x)$ = ___________

**Problem 3 – The "What's my Rule?" Challenge**

The rule challenge is to make up a new rule (of the form $ax + b$ or $ax^2 + b$) for $f(x)$, and have a partner guess your rule by using the nomograph.

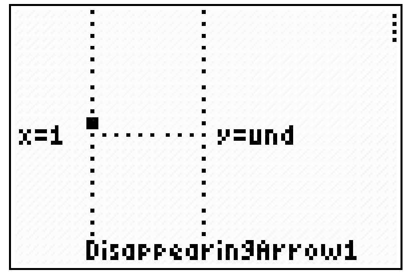



Choose **1:What'sMyRule > 3:RuleChallenge** from the menu. When prompted, enter an expression to complete the function and press [ENTER]. Then, exchange graphing calculators with your partner, who will use the nomograph to discover your rule. Then, repeat.

List at least four of the functions you and your partner explored with the nomograph.

$f(x)$ = ___________ $f(x)$ = ___________ $f(x)$ = ___________ $f(x)$ = ___________

## Problem 4 – The case of the disappearing arrow

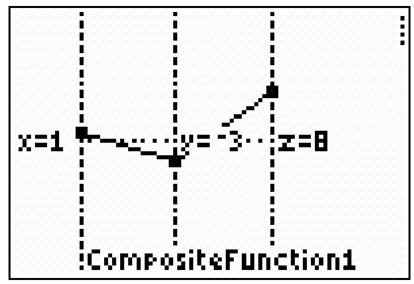



Return to the program’s main menu and choose **2:DisappearArrow > 1:Disappear1** to show a nomograph for the function $f(x)=\sqrt{x^2-4}$ . Enter values for *x*. Observe what happens as the value of *x* changes.

When does the arrow disappear? _________________

Why does the arrow disappear? __________________

## Problem 5 – Composite functions: “wired in series”




Choose **3:CompositeFunc > 1:CompositeFunc1** and enter a value for *x*.

This nomograph consists of three vertical number lines and behaves like *two* function machines wired in series. The point at *x* identifies a domain value on the first number line and is dynamically linked by the function $f_1(x) = 3x - 6$ to a range value *y* on the middle number line. That value is then linked by a second function $f_2(x) = -2x + 2$ to a value *z* on the far right number line.

Either of the two notations $f_2(f_1(x))$ or $f_2 \circ f_1$ can be used to describe the ***composite function*** that gives the result of applying function $f_1$ *first*, and then applying function $f_2$ to that result.

For example, the number 4 is linked to 6 by $f_1$ (because $f_1(4) = 6$), which in turn is linked to –10 by $f_2$ (because $f_2(6) = -10$). Set $x = 4$ and confirm that $y = 6$ and $z = -10$.

Find a rule for the single function $f3$ that gives the same result as $f_2(f_1(x))$ for all values of *x*. To test your answer, return to the **3:RuleChallenge** (What’s My Rule) and define $f_3$ to be your function.

$f_3(x)$ = ________________

Now compute several values, for each function, such as $f_2(f_1(4))$ and $f_3(4)$. Are they equal?

Compute and compare the following.

$f_2(f_1(3))$ = __________ $f_1(f_2(3))$ = __________

Try other values of *x*. Does the order in which you apply the functions matter?

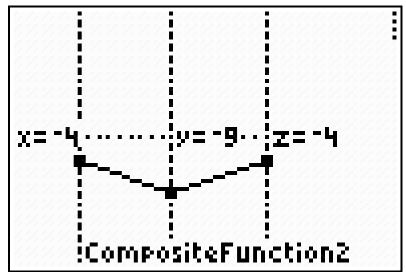
Test your understanding by completing another example:

In **3:CompositeFunc > 3:MakeYourOwn**, $f_1(x) = (x - 1)^2$ and $f_2(x) = 2x + 3$. Find a rule for both $f_2 \circ f_1$. Then switch the order of the functions and find a rule for $f_1 \circ f_2$. Test your answer by computing several values for each function.

$f_2(f_1(x))$ = ________________ $f_1(f_2(x))$ = ________________

**Problem 6 – A well-behaved composite function**

Some composite functions are more predictable than others. The nomograph in **2:CompositeFunc2** shows the function $f_1(x) = 3x + 3$ composed with a mystery function $f_2$. Grab and drag the base of the arrow at $x$.




What do you notice about the composite function $f_2 \circ f_1$?

Play "What's my Rule?" to find the rule for $f_2$.

$f_2(x)$ = ________

Use **3:MakeYourOwn** to compute and compare the following.

$f_2(f_1(3))$ = __________ $f_1(f_2(3))$ = __________

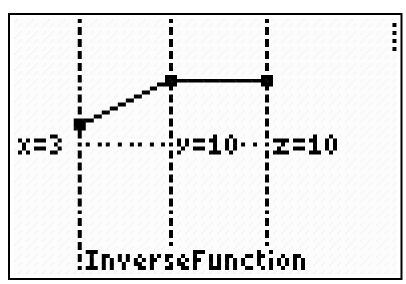
Try other values of $x$. Does the order in which you apply the functions matter?

**Problem 7 – Inverse functions**

The "inverse" of a function $f$, denoted $f^{-1}$, "undoes" the function—it maps a point $y$ from the range back to its original $x$ from the domain. You can think of a function and its inverse as a special case of function composition. (This is what was shown in Problem 6.)

By definition, $f_2$ is the inverse of $f_1$, if and only if:

- $f_2(f_1(x)) = x$ for every $x$ in the domain of $f_1$, and
- $f_1(f_2(x)) = x$ for every $x$ in the domain of $f_2$.




In the context of the nomograph, $f_2$ is the inverse of $f_1$ if $f_2(f_1(x))$ horizontally aligns with $x$ for all values in the domain of $f_1$ (i.e. $z = x$), and vice versa.

The nomograph in **4:InverseFunc > 1:InverseFunc.** shows the composite function $f_2 \circ f_1$, where $f_1(x) = 2x + 4$ and $f_2(x) = x$. See if you can figure out what the rule for $f_2$ must be in order for $f_1$ and $f_2$ to be inverse functions. When prompted, enter an expression to complete the function and an $x$-value to test your answer.

**f2**($x$) = ________________

**Problem 8 – Disappearing arrows in a composite function**

The nomograph in **2:DisappearArrow > 2:Disappear2** shows the composite function $f_2 \circ f_1$ where $f_1(x) = 2x - 6$ and $f_2(x) = \sqrt{x}$. Try several values of $x$. Watch as one of the arrows disappears.

Which arrow disappears? ______________

When and why does it disappear? _________________________________

**Problem 9 – "Almost" inverses and more missing arrows**

The nomograph in **4:InverseFunc > 2:AlmostInverse1** shows the composite function $f_2 \circ f_1$ where $f_1(x) = \sqrt{x}$ and $f_2(x) = x^2$. Enter several values for $x$.

When does $f_2$ act like the inverse of $f_1$? ______________

When does $f_2$ *NOT* act like the inverse of $f_1$? ______________

When and which arrow(s) disappears? ______________

The nomograph is **4:InverseFunc > 3:AlmostInverse2** reverse the definitions, that is, defines $f_1(x) = x^2$ and $f_2(x) = \sqrt{x}$.

Test some values for $x$ in the nomograph.

When does $f_2$ act like the inverse of $f_1$? ______________

When does $f_2$ *NOT* act like the inverse of $f_1$? ______________

When and which arrow(s) disappears? ______________