Lesson plan notes:

Warm-up:

You have decided to buy a season pass to Schlitterbahn which now costs $130. Luckily you found two discount coupons. One gives you 10% off the transaction and the other is $10 off the transaction. Does it matter which coupon you use first? Show why or why not.

Let *p* be the purchase price, *D (p)* be the final price using the 10% discount, *T (p)* be the final price using the $10 off. Write an equation for the final costs C_1 and C_2 of the final price if both discounts are used in different orders.

We can add, subtract, multiply, and divide functions. But for the most fun we like to nest one function inside another like the little Russian Dolls. We call this **Function Composition and w**e indicate this operation with a "$\circ$".

It looks like this $(f \circ g)(x) = f(g(x))$. Let's try one.

Example (a)

Let $f(x) = \frac{1}{x}$, $g(x) = 2 - x$ Find $f \circ g$ and $g \circ f$ and $g \circ g$

Example (b)

For $f(x) = \frac{1}{x+2}$, $g(x) = \frac{4}{x-1}$ Find $f \circ g$ and $g \circ f$

Saying $f(g(x))$ makes me out of breath so let's rename this guy.

$h(x) = f(g(x))$. From above what is the Domain of $h(x)$?

So far, we have combined only two functions, but nothing limits us so find $f \circ g \circ h$ for:

$f(x) = \frac{x}{x+1}$, $g(x) = x^3$, $h(x) = x - 2$

We can also go in reverse

This is called Function Decomposition, and it goes a little something like this….hit it!

$h(x) = \sqrt[3]{x+3} - 3$ We want to pick apart the equation so that we have $f(x) and\ g(x)$

such that $f\left(g(x)\right) = h(x)$. How many ways can you find?

What is **One-to-One**?

In basket ball we can play one-on-one.

In math we say that: If for $f(x)$, every x-value (input) corresponds to only one y-value (output), the function is **one-to one.** Functions that are one-to-one, are said to be **Invertible**. We would say that the inverse of $f(x)$ is $f^{-1}(x)$.This can be shown by mapping, tables, graphically, and algebraically.

Mapping example:

Graphing example: (horizontal line test)

Algebraically

We can find the inverse of a function $f(x)$ by following a stepped process.

1. Swap the *x's* and *y's*
2. Solve for *y*
3. Verify our result by showing $f(f^{-1}(x)) = x = f^{-1}(f(x))$

Let's practice. Find the inverse of:

a) $f(x) = 3x + 4$

b) $g(x) = \frac{1}{x-2}$

c) $h(x) = x^3 - 1$

d) $p(x) = x^2 + 4,\ x \geq 0$

e) $n(x) = \frac{-3x-4}{x-2}$

f) $t(x) = \frac{x^2+3}{3x^2},\ x > 0$

What about the last step? Check/verify?

We use Function Composition to show $f(f^{-1}(x)) = x = f^{-1}(f(x))$. This is only true if the functions are inverses of each other. Using the examples above, verify via function composition that the inverse we found is correct.