Warm Up 9/10

1. Define function

For every input there's exactly one output.

2. Evaluate $f(0)$ and $f(2)$ for the following.

a. $f(x) = x^2$

$f(0) = 0$

$f(2) = 4$

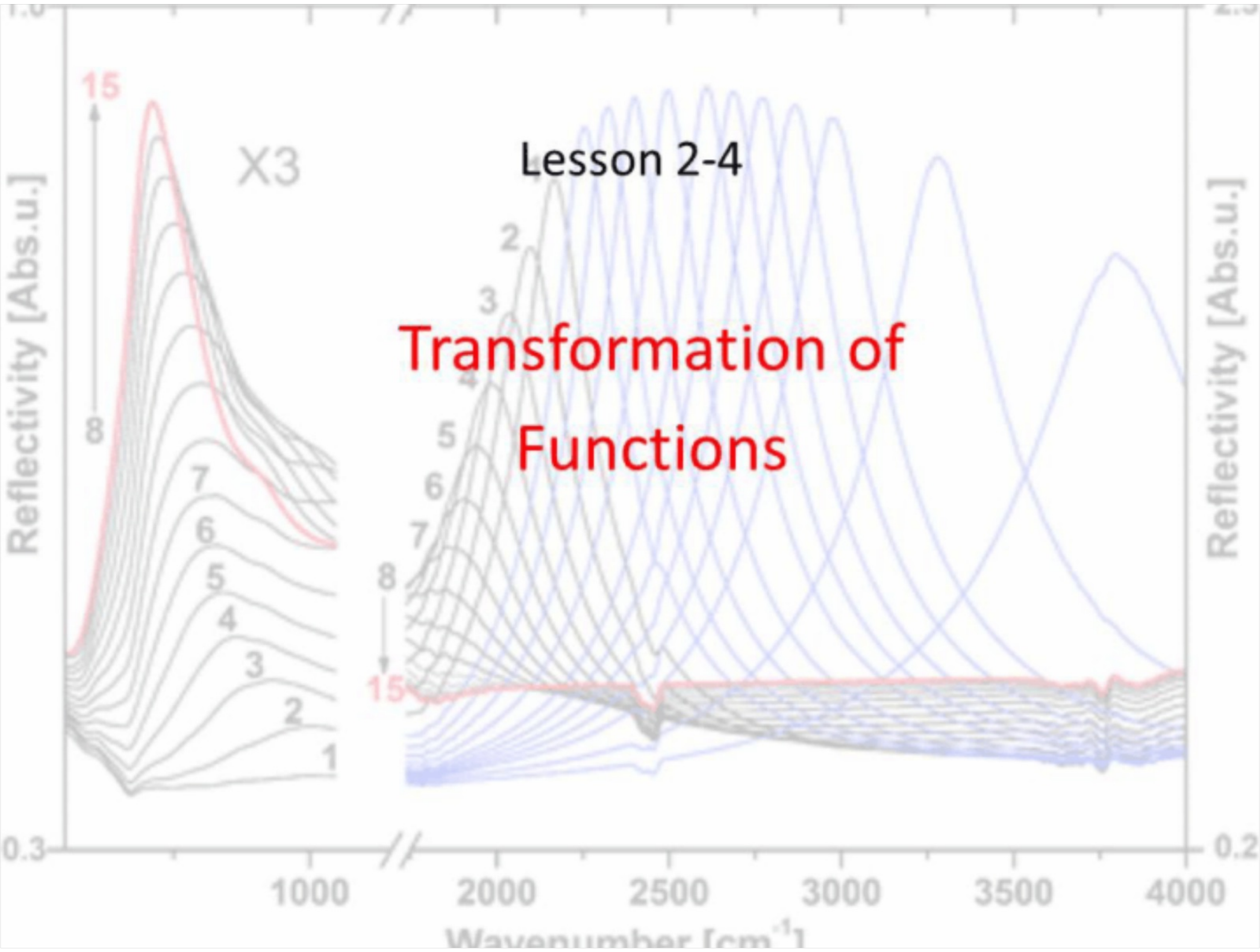
b. $g(x) = x^2 - 2$

$g(0) = -2$

$g(2) = 2$

Lesson 2-4

Transformation of Functions



Objective

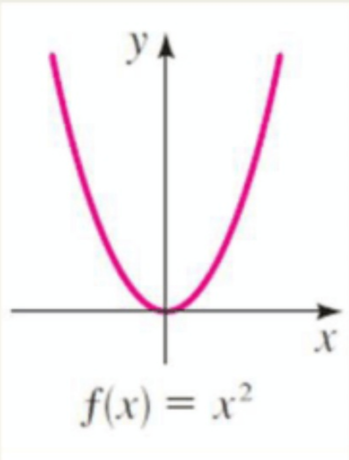
Students will…

- Be able to understand the basic idea of transformation of functions.
- Explore and apply the properties of vertical and horizontal shifts.

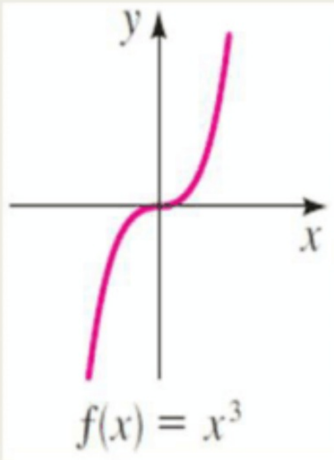
"Parent" Functions

We have seen and studied some of the standard functions and their graphs. For example.

$f(x) = x^2$



$f(x) = x^3$



Transformation of Functions

$g(x) = \sqrt{x} + 2$

Now, consider our problem from the warm up. Let's go ahead and compare the two functions: $f(x) = x^2$ and $g(x) = x^2 + 2$

$g(x) = f(x) + 2$

Transformation: Vertical Shift

$g(x) = \boxed{\sqrt{x}} + 2$

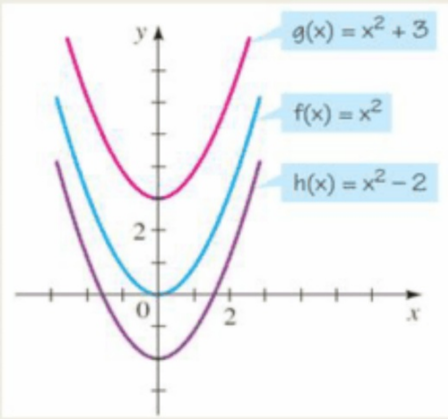
As observed, the difference between $f(x)$ and $g(x)$ was that $g(x)$ was simply $f(x)$ vertically **shifted up 2 units**. This can be generalized by the following:

$y = x$
$y = x + 3$

> $y = f(x) \pm c$ shifts the graph of $y = f(x)$ upward(+) or downward(-) c units, for $c > 0$.

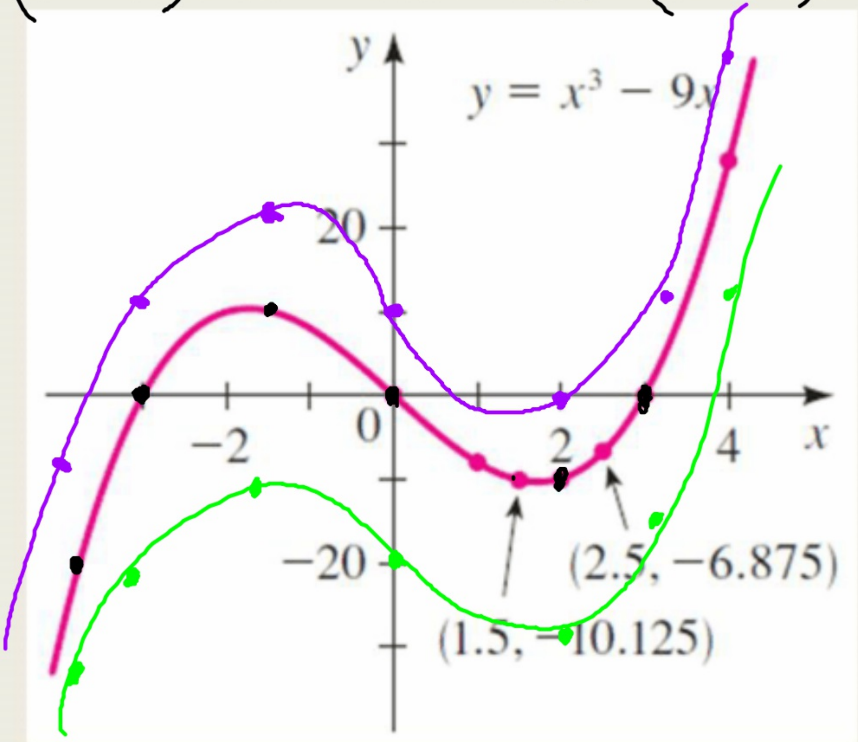
Ex. Use the graph of $f(x) = x^2$ to sketch the graph of,

$g(x) = x^2 + 3$ and $h(x) = x^2 - 2$



Example

Use the graph of $f(x) = x^3 - 9x$ shown below to sketch the graph of $g(x) = (x^3 - 9x) + 10$ and $h(x) = (x^3 - 9x) - 20$



Transformation: Horizontal Shift

Similar to vertical shift, we also have a **horizontal shift**. Let's compare the three functions: $f(x) = x^2$, $g(x) = (x+2)^2$, $h(x) = (x-1)^2$

	x^2
$1 \to$	1
$2 \to$	4
$0 \to$	0

	$(x+2)^2$
$-1 \to$	
$0 \to$	
$-2 \to$	

Transformation: Horizontal Shift

$j(x) = \sqrt{x-2}$

$\sqrt{x}$

So the horizontal shift can also be generalized.

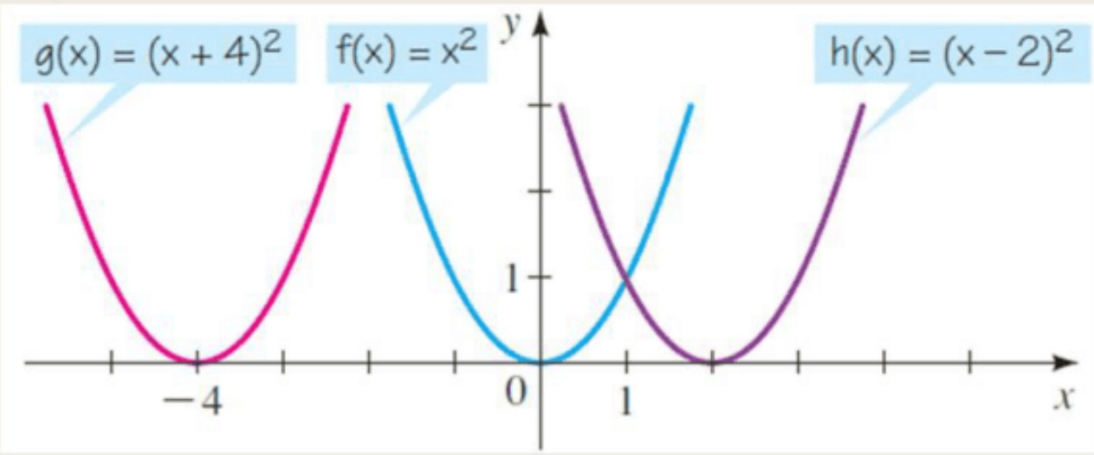
left

$y = f(x \pm c)$ shifts the graph of $y = f(x)$ to the [redacted](+) or [redacted](-) c units, for $c > 0$. Note the **opposite** signs!

right

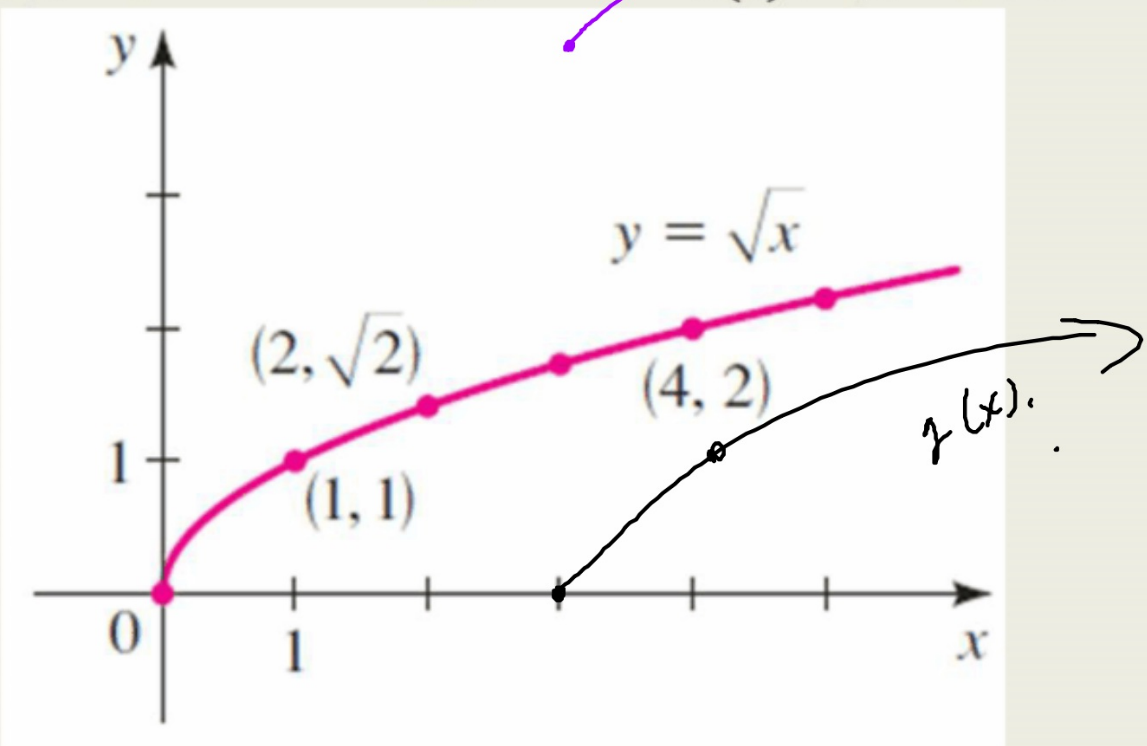
Ex. Use the graph of $f(x) = x^2$ to sketch the graph of,

$g(x) = (x+4)^2$ and $h(x) = (x-2)^2$



Example

Use the graph of $f(x) = \sqrt{x}$ shown below to sketch the graph of
$g(x) = \sqrt{x-3}$ and $h(x) = \sqrt{x-3} + 4$



Examples

Describe the shift of the function: $g(x) = (x + 11)^2 - 2$ from its "parent" function, $f(x) = x^2$

left 11, down 2

Describe the shift of the function $h(x) = (x - 6)^5 + 1$ from its "parent" function, $f(x) = x^5$

HI

Describe the shift of the function $p(x) = \sqrt{x + 5} - 4$ from its "parent" function, $f(x) = \sqrt{x}$

Homework 9/10

TB pg. 190 #1-3, 7, 11, 13, 19 (a, b, d), 27, 28, 33, 37, 39