1.2 Notes: Calculus **Functions**

Most of calculus revolves around the study of functions
Definition: A function is a set of ordered pairs such that no two distinct pairs have the same first element (x, y)

Functions are rules that assign values
The first element (usually x's) are called the domain and are called the independent variable
The second element (usually y's) are called the range and are called the dependent variable.

It is possible to restrict domains. For example $y = x^2$ or $y = \sqrt{x}$

To do so we use inequality notation or interval notation
Example:

$x > 0$	$(0, \infty)$	
$x \geq 0$	$[0, \infty)$	
$a < x < b$	(a, b)	*open*
$a \leq x \leq b$	$[a, b]$	*closed*
$a < x \leq b$	$(a, b]$	

Graphing functions is simply a matter of finding ordered pairs that satisfy the function and then plotting them on a coordinate plane. This can be done by using an x-y table, intercepts, parent graphs, symmetry, odd/even, and/or calculator

Graph: $f(x) = \sqrt{4 - x^2}$

Parent graphs can be very helpful.

$f(x) = mx$	$f(x) = x^2$	$f(x) = x^3$
$f(x) = \frac{1}{x}$	$f(x) = \sqrt{x}$	$f(x) = \sqrt[3]{x}$
$f(x) = \frac{1}{x^2}$	$f(x) = x^{\frac{3}{2}}$	$f(x) = x^{\frac{2}{3}}$

Even and Odd functions
The usefulness of knowing whether a function is odd or even cannot be underestimated.
Test y = f(x) is a function

Even if f(-x) = f(x)	if (x, y) is on graph so is (-x, y)	symmetric over y-axis
Odd if f(-x) = -f(x)	if (x, y) is on graph so is (-x, -y)	symmetric over origin

Two simple examples:
even $y = x^2$
odd $y = x^3$
Examine the symmetry on a calculator

Piece-wise Functions
Piece-wise functions will be encountered much more in the study of calculus.

Consider $y = f(x) = \begin{cases} -2 & x < 0 \\ x^2 & 0 \le x < 2 \\ 4 & x \ge 2 \end{cases}$

Look at Figure 1.18 on page 17. Write a formula for this piecewise function.

Write a formula for $y = |x|$

Example 7 page 17 $f(x) = |x-2| - 1$
Use a calculator to graph it.
Now use the parent graph approach.

Composition of functions
Because this is calculus and things are so complicated we can't talk about functions without discussing composition of functions.

Two main symbolic representations are $f \circ g$ *or* $f(g(x))$

"plug x into g, take that answer, plug into f to get final answer f of g."

$x \to g \to f \to answer$

Caution: you must be careful with domain and range of composed functions. Whatever comes out of the first must be legal to plug into the second.

Example #63 page 21

$f(x) = x - 7$ $g(x) = \sqrt{x}$
Find and graph $f \circ g$ *and* $g \circ f$