## Practice

a) Since the function f(x) has symmetry with respect to the y-axis, we can make the conjecture that f(x) is an even function.

b) In order to prove that f(x) is an even function, we must show that f(x) = f(-x).

$f(x) = x^8 + \frac{1}{10}x^2 - 1$ $\quad f(-x) = (-x)^8 + \frac{1}{10}(-x)^2 - 1$

$= x^8 + \frac{1}{10}x^2 - 1$

odd

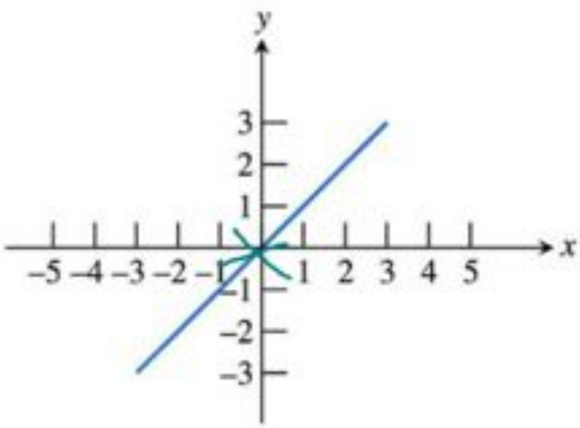
$f(-x) = -f(x)$

Since f(x) = f(-x), we have shown that f(x) is an even function.

# WARM UP: (5 minutes)

- Get a textbook. (Bookcase)
- Get "Twelve Basic Functions" Handout (Your Desk)
- Get a "Graphic Orgranizer" (Your Desk)
- Get an envelope with function manipulatives. (Teacher Desk)
  - Check your envelope for graphs 1-12.
  - Check your envelope for functions a – l.
  - If necessary replace missing cut outs from spare pieces envelopes. (Teacher Desk.)
- 5 minutes of AM ..etc. Do it …scan it!

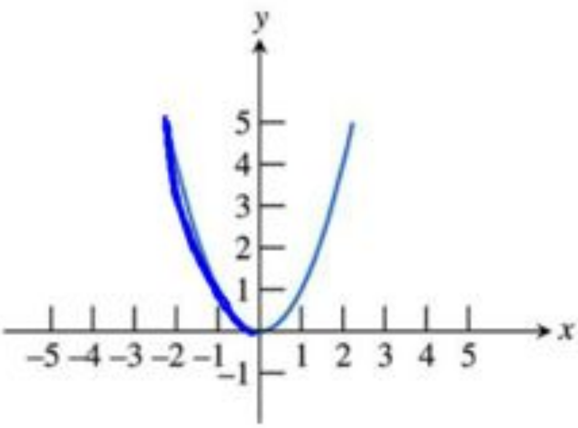
## The Identity Function




$f(x) = x$

Interesting fact: This is the only function that acts on every real number by leaving it alone.

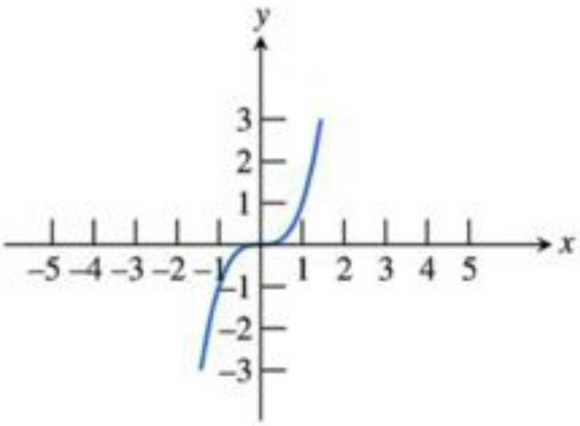
# The Squaring Function




$f(x) = x^2$

Interesting fact: The graph of this function, called a parabola, has a reflection property that is useful in making flashlights and satellite dishes.

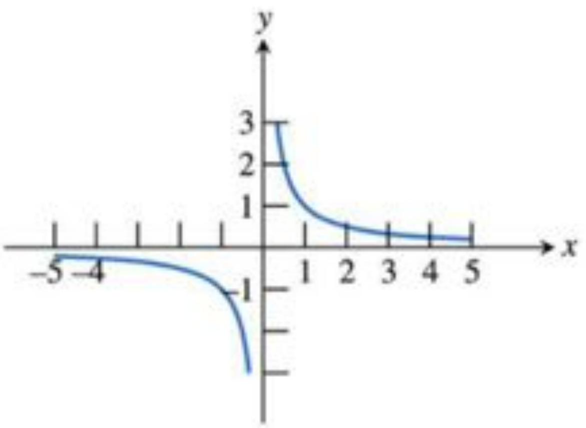
# The Cubing Function




$f(x) = x^3$

Interesting fact: The origin is called a "point of inflection" for this curve because the graph changes curvature at that point.

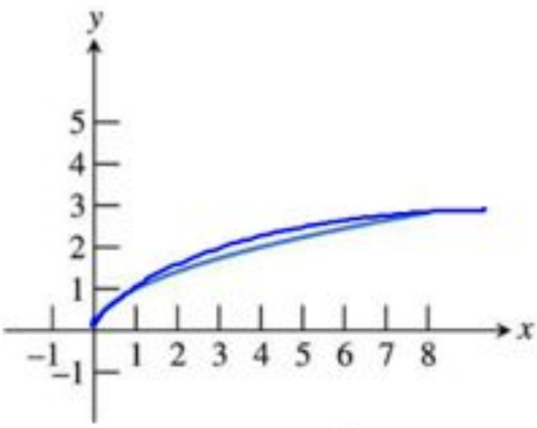
# The Reciprocal Function




$$f(x) = \frac{1}{x}$$

Interesting fact: This curve, called a hyperbola, also has a reflection property that is useful in satellite dishes.

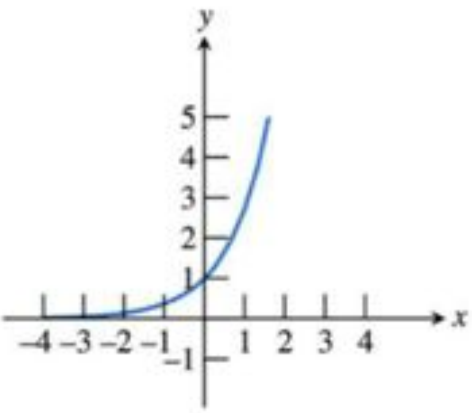
## The Square Root Function




$$f(x) = \sqrt{x}$$

Interesting fact: Put any positive number into your calculator. Take the square root. Then take the square root again. Then take the square root again, and so on. Eventually you will always get 1.

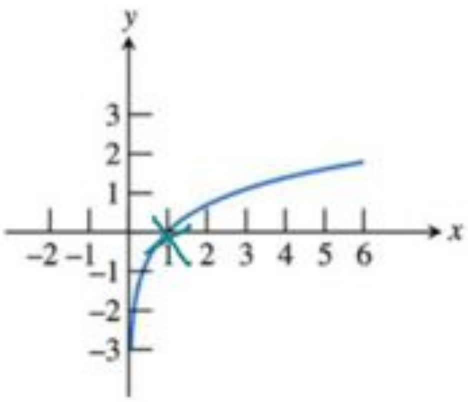
# The Exponential Function




$f(x) = e^x$

Interesting fact: The number $e$ is an irrational number (like $\pi$) that shows up in a variety of applications. The symbols $e$ and $\pi$ were both brought into popular use by the great Swiss mathematician Leonhard Euler (1707–1783).

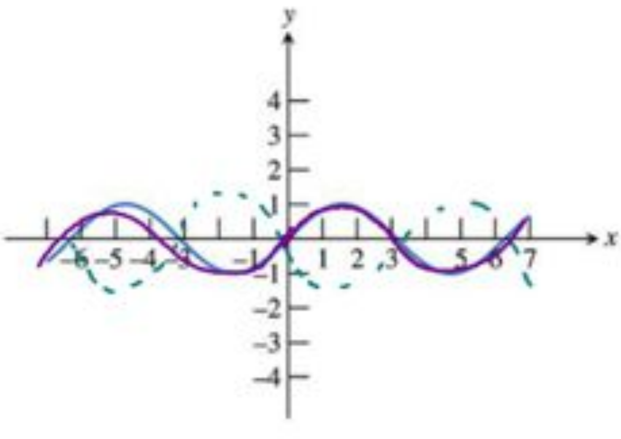
# The Natural Logarithm Function




$f(x) = \ln x$

Interesting fact: This function increases very slowly. If the $x$-axis and $y$-axis were both scaled with unit lengths of one inch, you would have to travel more than two and a half miles along the curve just to get a foot above the $x$-axis.

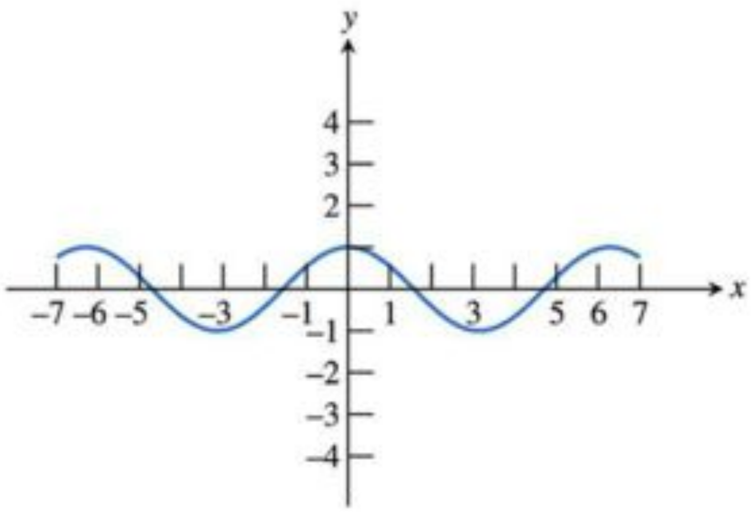
# The Sine Function




$f(x) = \sin x$

Interesting fact: This function and the sinus cavities in your head derive their names from a common root: the Latin word for "bay." This is due to a 12th-century mistake made by Robert of Chester, who translated a word incorrectly from an Arabic manuscript.

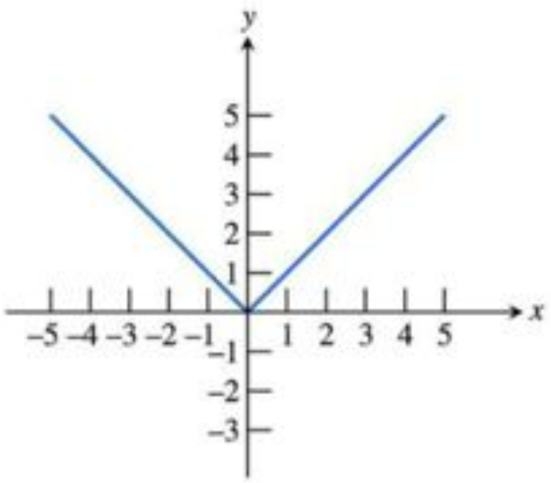
# The Cosine Function




$f(x) = \cos x$

Interesting fact: The local extrema of the cosine function occur exactly at the zeros of the sine function, and vice versa.

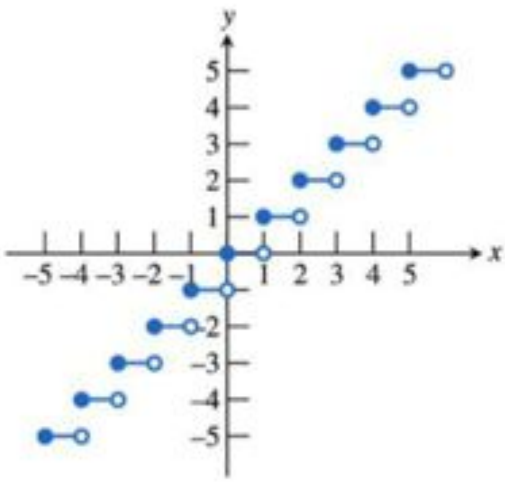
# The Absolute Value Function




$f(x) = |x| = \text{abs}(x)$

Interesting fact: This function has an abrupt change of direction (a "corner") at the origin, while our other functions are all "smooth" on their domains.

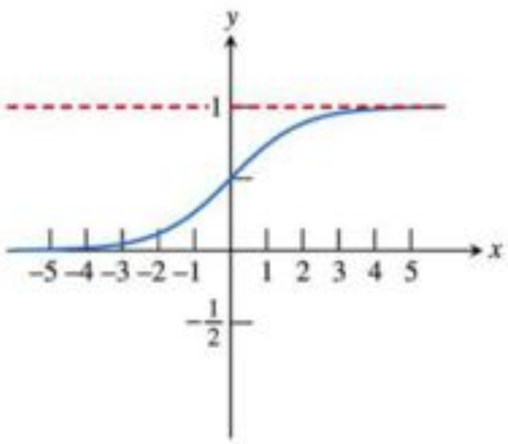
# The Greatest Integer Function




$f(x) = \text{int}(x)$

Interesting fact: This function has a jump discontinuity at every integer value of $x$. Similar-looking functions are called *step functions.*

# The Logistic Function




$$f(x) = \frac{1}{1 + e^{-x}}$$

Interesting fact: There are two horizontal asymptotes, the $x$-axis and the line $y = 1$. This function provides a model for many applications in biology and business.

## Today's Objectives

- Talk about to the different mathematical characteristics of the 12 major function types and use the descriptions to **classify** **given functions** with a partner.

- Success Criteria
  - Identify the domain, range, continuity, bounds, symmetry, and/or end behavior of the twelve basics functions and their transformations

- Vocabulary: identity, squaring, cubing, reciprocal, square root, exponential, natural logarithm, sine, cosine, greatest integer, absolute value, logarithmic

## Function Properties Investigation Part 1.

INDIVIDUAL WORK:

1. Use "Twelve Basics Functions" to choose function that fit descriptions given in Exercises #19 – 28 on page 113-114.
2. To track your category choices, write the names of appropriate functions on the graphic organizer. NOTE: Some functions may fit more then one category.

GROUP WORK:

- Discuss your categories within your groups.
- Come to a consensus. Be prepared to report out.

## The four basic functions that are odd.

(#19, pg 113)

The identity function $f(x)=x$

The cubing function $f(x)=x^3$

The reciprocal function $f(x)=\frac{1}{x}$

The sine function $f(x)=\sin(x)$

## The six basic functions that are increasing on their entire domains. (#20, pg 113)

The identity function
The cubing function
The square root function
The natural logarithm function
The exponential function
The logistic function

## The three basic functions that are decreasing on the interval $(-\infty,0)$. (#21, pg 113)

**The squaring function**
**The absolute value function**
**The reciprocal function**

## The three basic functions with infinitely many local extrema. (#22, pg 113)

**The sine function**
**The cosine function**
**The greatest integer function**

## The three basic functions with no zeros. (#23, pg 113)

**The reciprocal function**
**The logistic function**
**The exponential function**

What do the ranges of these functions have in common? **They do not include zero**

## The three basic functions with range $\{\text{all real numbers}\}$. (#24, pg 113)

**The identity function**
**The cubing function**
**The natural logarithm**

The four basic functions that **do not have the end behavior**, as x approaches positive infinity y approaches positive infinity, in notation we write $\lim_{x \to +\infty} f(x) = +\infty$ (#25, pg 113)

**The reciprocal function**
**The sine function**
**The cosine function**
**The logistic function**

The three basic functions **with end behavior** as x approaches positive infinity y approaches negative infinity, in notation we write $\lim_{x \to -\infty} f(x) = -\infty$ (#26, pg 113).

**The identity function**
**The cubing function**
**The greatest integer function**

## The four basic functions whose graphs look the same when turned upside-down and flipped about the y-axis (#27, pg 113)

**The reciprocal function**
**The sine function**
**The identity function**
**The cubing function**

The two basic functions whose graphs are identical except for a horizontal shift. (#28, pg 113)

**The sine function**
**The cosine function**