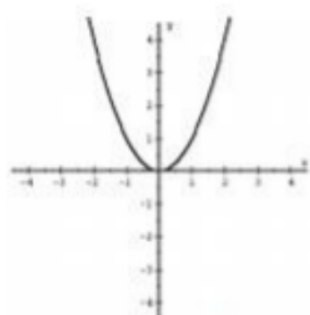
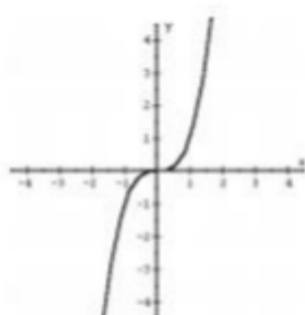


Four Basic Parent Functions:

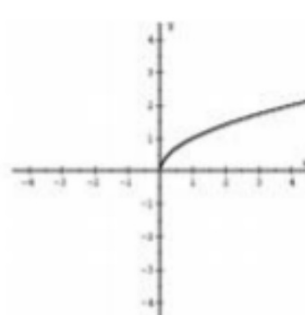
We will examine four basic functions and the parent graphs associated with each. This idea can be expanded to many other functions such as cube root, exponential and logarithmic functions.



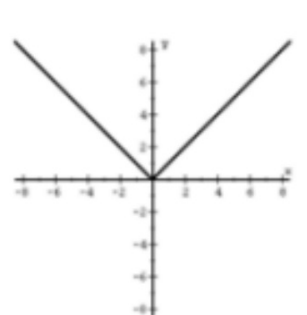
$f(x) = x^2$
Quadratic



$f(x) = x^3$
Cubic



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



$f(x) = |x|$
Absolute Value

To examine transformations of these functions we must consider the following form of each equation:

$$f(x) = a(x - h)^2 + k \quad f(x) = a(x - h)^3 + k \quad f(x) = a\sqrt{x - h} + k \quad f(x) = a|x - h| + k$$

The values of a , h and k dictate the transformations of each of the functions.

Horizontal Translations:

h dictates whether or not any of the parent functions are translated to the LEFT or to the RIGHT.

For Example: In $f(x) = (x - 2)^2$, $h = 2$. Therefore the parent graph is translated 2 units to the RIGHT.

In $f(x) = \sqrt{x + 3}$, $h = -3$. Therefore the parent graph is translated 3 units to the LEFT.

Vertical Translations:

k dictates whether or not any of the parent functions are translated to UP or to DOWN.

For Example: In $f(x) = x^2 + 5$, $k = 5$. Therefore the parent graph is translated 5 units UP.

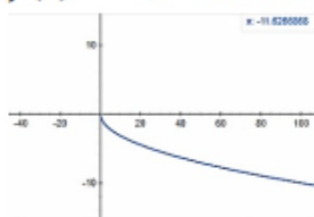
In $f(x) = \sqrt{x} - 1$, $k = -1$. Therefore the parent graph is translated 1 unit DOWN.



Reflection Over the x-axis:

If a is negative, then the parent graph is reflected over the x-axis.

For Example: The graph of $f(x) = -\sqrt{x}$ would look like:



For Example: The graph of $f(x) = -|x|$ would look like:



Vertical Stretching and Shrinking:

If $|a| > 1$, then the parent graph is stretched by a factor of a .

If $0 < |a| < 1$, then the parent graph is shrunk by a factor of a .

This means that all of the y-coordinates on the transformed graph are found by multiplying the y-coordinates on the parent graph by a .

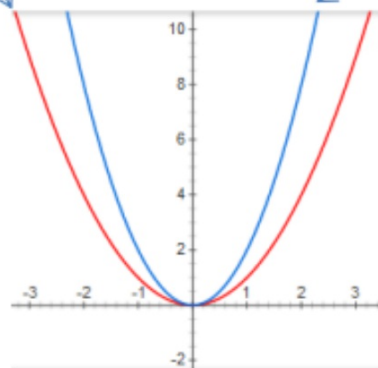
For Example: $f(x) = 2(x)^2$ ----- Multiply the y-coordinates by 2.

Parent Graph

x	y
-2	4
-1	1
0	0
1	1
2	4

Stretched Graph

x	y
-2	8
-1	2
0	0
1	2
2	8



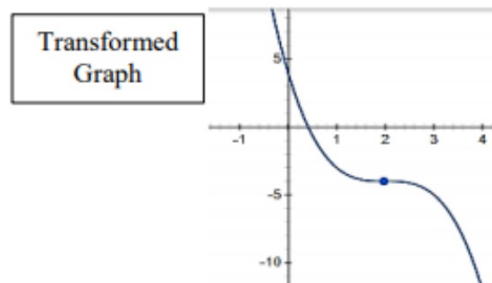
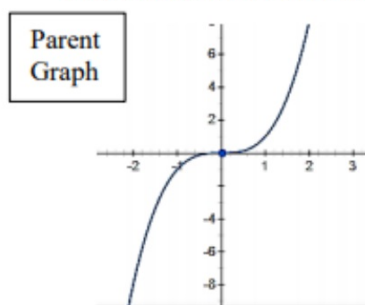
Multiple Transformations:

If a function has multiple transformations, they are applied in the following order:

1. Horizontal translation
2. Reflection, Stretching, Shrinking
3. Vertical Translation.

For Example: $f(x) = -(x - 2)^3 - 4$

This function will be translated RIGHT 2, reflected over the x-axis, and DOWN 4.



$$y = -2(x + 4)^3 - 1$$

