

Name Key

## What Is a Parent Function??

It is the most basic form of a function of a "family" of Functions.

**Quadratic Family:**  $f(x) = x^2$  is the parent function because it is the simplest form of a quadratic equation that still makes a parabola.

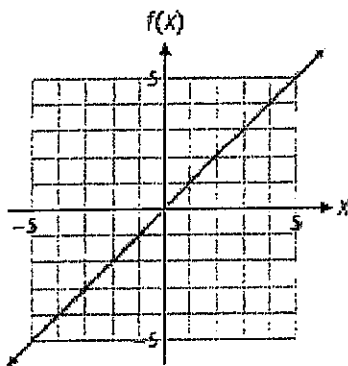
**Cubic Family:**  $f(x) = x^3$  is the parent function because it is the simplest for a cubic equation that still makes the curvy shape of a cubic function.

**Linear Family:**  $f(x) = x$  is the parent function because it is the simplest form of a linear equation that still makes a line.

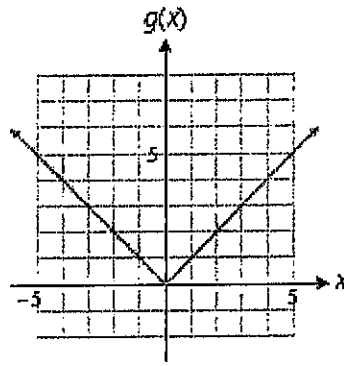
**Absolute value Family:**  $f(x) = |x|$  is the parent function because it is the simplest form of an absolute value equation that still makes the V shape of an absolute value function.

**Square Root Family:**  $F(x) = \sqrt{x}$  is the parent function because it is the simplest form of a square root function that still makes the curve shape of a square root function.

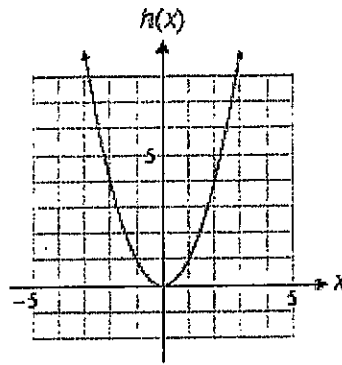
**Cube Root Family:**  $f(x) = \sqrt[3]{x}$  is the parent function because it is the simplest form of a cube root function that still makes the curvy shape of a cube root function.



(a) Identity function  
 $f(x) = x$   
Domain:  $\mathbb{R}$   
Range:  $\mathbb{R}$

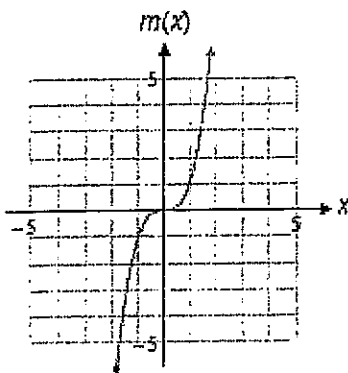


(b) Absolute value function  
 $g(x) = |x|$   
Domain:  $\mathbb{R}$   
Range:  $[0, \infty)$

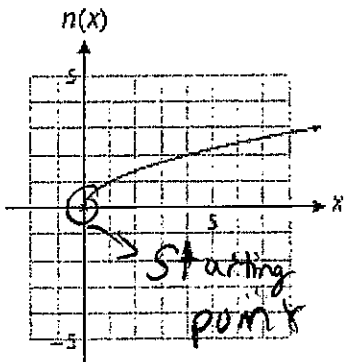


(c) Square function  
 $h(x) = x^2$   
Domain:  $\mathbb{R}$   
Range:  $[0, \infty)$

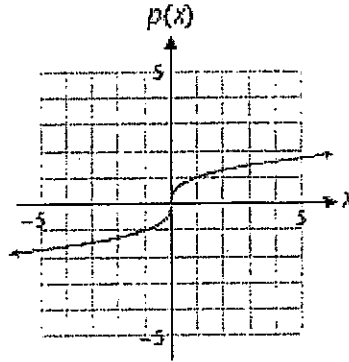
\* All of these have the same Tip/Vertex of (0,0)



(d) Cube function  
 $m(x) = x^3$   
Domain:  $\mathbb{R}$   
Range:  $\mathbb{R}$



(e) Square root function  
 $n(x) = \sqrt{x}$   
Domain:  $[0, \infty)$   
Range:  $[0, \infty)$



(f) Cube root function  
 $p(x) = \sqrt[3]{x}$   
Domain:  $\mathbb{R}$   
Range:  $\mathbb{R}$

Figure 1 Some basic functions and their graphs.

# EFFECTS OF TRANSFORMATIONS ON PARENT FUNCTION GRAPHS

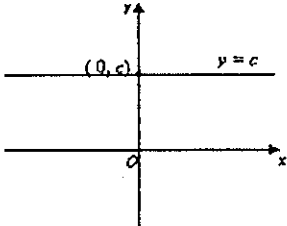
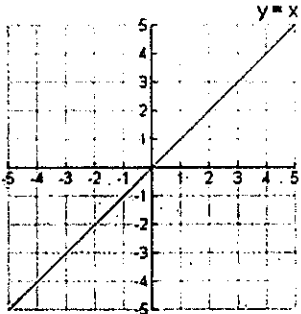
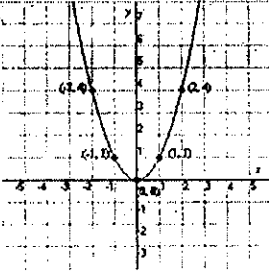
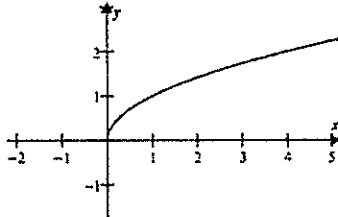
Parent Function	Identity (Linear) $f(x) = x$ $f(x) = mx + b$	Quadratic $f(x) = x^2$	Exponential $f(x) = b^x, b > 0, b \neq 1$ (this example, $b = 2$ )	Square Root $f(x) = \sqrt{x}, x \geq 0$	Absolute Value $f(x) =  x $
Parent Graph					
$f(x) + a$ Graph moves up $a$ units.	$f(x) = x + 2$ 	$f(x) = x^2 + 2$ 	$f(x) = 2^x + 2$ 	$f(x) = \sqrt{x} + 2$ 	$f(x) =  x  + 2$ 
$f(x) - a$ Graph moves down $a$ units.	$f(x) = x - 2$ 	$f(x) = x^2 - 2$ 	$f(x) = 2^x - 2$ 	$f(x) = \sqrt{x} - 2$ 	$f(x) =  x  - 2$ 

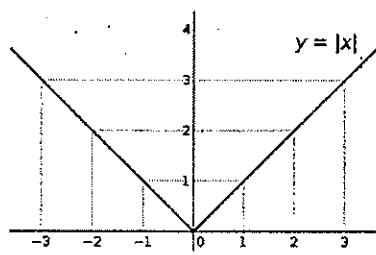
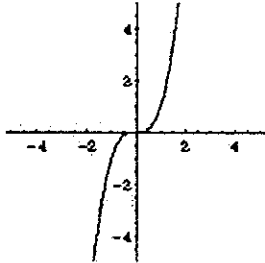
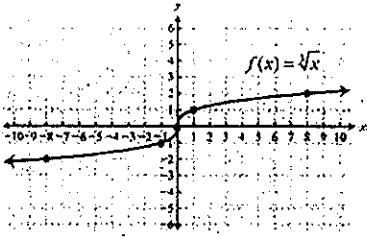
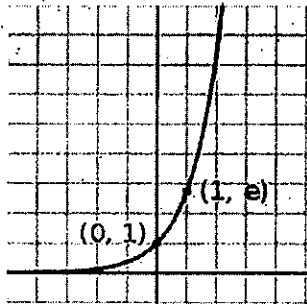
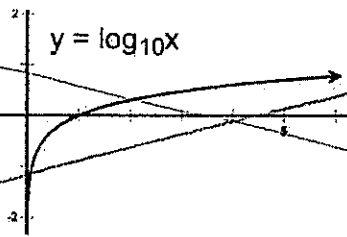
4.5

$f(x + a)$ Graph moves LEFT $a$ units.	$f(x) = (x + 2)$ 	$f(x) = (x + 2)^2$ 	$f(x) = 2^{(x + 2)}$ 	$f(x) = \sqrt{x + 2}$ 	$f(x) =  x + 2 $ 
$f(x - a)$ Graph moves RIGHT $a$ units.	$f(x) = (x - 2)$ 	$f(x) = (x - 2)^2$ 	$f(x) = 2^{(x - 2)}$ 	$f(x) = \sqrt{x - 2}$ 	$f(x) =  x - 2 $ 
$-f(x)$ Graph is reflected over the x-axis.	$f(x) = -x$ 	$f(x) = -x^2$ 	$f(x) = -(2^x)$ 	$f(x) = -\sqrt{x}$ 	$f(x) = - x $ 
$f(-x)$ Graph is reflected over the y-axis.	$f(x) = (-x)$ 	$f(x) = (-x)^2$ 	$f(x) = 2^{-x}$ 	$f(x) = \sqrt{-x}$ 	$f(x) =  -x $ 

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## Parent Functions

Function Name	Parent Function	Graph	Characteristics
Algebra			
Constant	$f(x) = c$		Domain: $(-\infty, \infty)$ Range: $[c, c]$ Inverse Function: Undefined (asymptote) Restrictions: $c$ is a real number Odd/Even: Even General Form: $Ay + B = 0$
Linear or Identity	$f(x) = x$		Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$ Inverse Function: $g(x) = x$ Restrictions: $m \neq 0$ Odd/Even: Odd General Forms: $Ax + By + C = 0$ $y = mx + b$ $y - y_0 = m(x - x_0)$
Quadratic or Square	$f(x) = x^2$		Domain: $(-\infty, \infty)$ Range: $[0, \infty)$ Inverse Function: $g(x) = \sqrt{x}$ Restrictions: None Odd/Even: Even General Form: $Ax^2 + By + Cx + D = 0$
Square Root	$f(x) = \sqrt{x}$		Domain: $[0, \infty)$ Range: $[0, \infty)$ Inverse Function: $g(x) = x^2$ Restrictions: $x \geq 0$ Odd/Even: Neither General Form: $f(x) = a\sqrt{b(x-h)} + k$

Function Name	Parent Function	Graph	Characteristics
Absolute Value	$f(x) =  x $		Domain: $(-\infty, \infty)$ Range: $[0, \infty)$ Inverse Function: $f(x) = x$ for $x \geq 0$ Restrictions: $f(x) = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}$ Odd/Even: Even General Form: $f(x) = a b(x-h)  + k$
Cubic	$f(x) = x^3$		Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$ Inverse Function: $g(x) = \sqrt[3]{x}$ Restrictions: None Odd/Even: Odd General Form: $f(x) = a(b(x-h))^3 + k$
Cube Root	$f(x) = \sqrt[3]{x}$		Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$ Inverse Function: $g(x) = x^3$ Restrictions: None Odd/Even: Odd General Form: $f(x) = a\sqrt[3]{b(x-h)} + k$
Exponential	$f(x) = 10^x$ or $f(x) = e^x$		Domain: $(-\infty, \infty)$ Range: $(0, \infty)$ Inverse Function: $f(x) = \log x$ or $f(x) = \ln x$ Restrictions: None, $x$ can be imaginary Odd/Even: Neither General Form: $f(x) = a10^{(b(x-h))} + k$
Logarithmic	$f(x) = \log x$ or $f(x) = \ln x$		Domain: $(0, \infty)$ Range: $(-\infty, \infty)$ Inverse Function: $g(x) = 10^x$ or $g(x) = e^x$ Restrictions: $x > 0$ Odd/Even: Neither General Form: $f(x) = a \log(b(x-h)) + k$