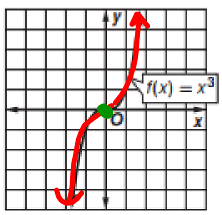
1-5 Study Guide and Intervention

Parent Functions and Transformations

Parent Functions A parent function is the simplest of the functions in a family.

Parent Function	Form	Notes
constant function	$f(x) = c$	graph is a horizontal line
identity function	$f(x) = x$	points on graph have coordinates (a, a)
quadratic function	$f(x) = x^2$	graph is U-shaped
cubic function	$f(x) = x^3$	graph is symmetric about the origin
square root function	$f(x) = \sqrt{x}$	graph is in first quadrant
reciprocal function	$f(x) = \frac{1}{x}$	graph has two branches
absolute value function	$f(x) = \lvert x \rvert$	graph is V-shaped
greatest integer function	$f(x) = [\![x]\!]$	defined as the greatest integer less than or equal to x; type of step function

Example **Describe the following characteristics of the graph of the parent function $f(x) = x^3$: domain, range, intercepts, symmetry, continuity, end behavior, and intervals on which the graph is increasing/decreasing.**



The graph confirms that $D = \{x \mid x \in \mathbb{R}\}$ and $R = \{y \mid y \in \mathbb{R}\}$.

The graph intersects the origin, so the x-intercept is 0 and the y-intercept is 0.

It is symmetric about the origin and it is an odd function: $f(-x) = -f(x)$. $f(-x) = (-x)^3 = -x^3$

The graph is continuous because it can be traced without lifting the pencil off the paper.

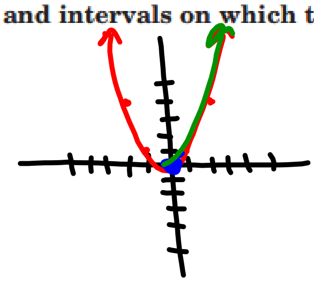
As x decreases, y approaches negative infinity, and as x increases, y approaches positive infinity.

$\lim_{x \to -\infty} f(x) = -\infty$ and $\lim_{x \to \infty} f(x) = \infty$

The graph is always increasing, so it is increasing for $(-\infty, \infty)$.

Exercise

Describe the following characteristics of the graph of the parent function $f(x) = x^2$: domain, range, intercepts, symmetry, continuity, end behavior, and intervals on which the graph is increasing/decreasing.



D: $(-\infty, \infty)$

R: $[0, \infty)$

x-int: $(0,0)$

y-int: $(0,0)$

sym. over y-axis

continuous

$\lim_{x\to-\infty} f(x) = \infty$ $\lim_{x\to\infty} f(x) = \infty$

increasing: $(0, \infty)$

decreasing: $(-\infty, 0)$

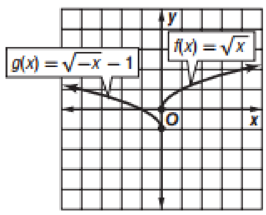
Parent Functions and Transformations

Transformations of Parent Functions Parent functions can be transformed to create other members in a family of graphs.

"moves" **Translations**	$g(x) = f(x) + k$ is the graph of $f(x)$ translated…	…k units up when $k > 0$.
		…k units down when $k < 0$.
	$g(x) = f(x - h)$ is the graph of $f(x)$ translated…	…h units right when $h > 0$.
		…h units left when $h < 0$.
Reflections	$g(x) = -f(x)$ is the graph of $f(x)$…	…reflected in the x-axis.
	$g(x) = f(-x)$ is the graph of $f(x)$…	…reflected in the y-axis.
change shape **Dilations**	$g(x) = a \cdot f(x)$ is the graph of $f(x)$…	…expanded vertically if $a > 1$.
		…compressed vertically if $0 < a < 1$.
	$g(x) = f(ax)$ is the graph of $f(x)$…	…compressed horizontally if $a > 1$.
		…expanded horizontally if $0 < a < 1$.

Example **Identify the parent function $f(x)$ of $g(x) = \sqrt{-x} - 1$, and describe how the graphs of $g(x)$ and $f(x)$ are related. Then graph $f(x)$ and $g(x)$ on the same axes.**

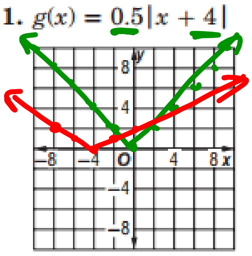
The graph of $g(x)$ is the graph of the square root function $f(x) = \sqrt{x}$ reflected in the y-axis and then translated one unit down.



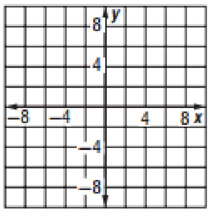
Exercises

Identify the parent function $f(x)$ of $g(x)$, and describe how the graphs of $g(x)$ and $f(x)$ are related. Then graph $f(x)$ and $g(x)$ on the same axes.

1. $g(x) = 0.5|x + 4|$



2. $g(x) = 2x^2 - 4$



parent function: $f(x) = |x|$
vertical dilation
horizontal translation

HW: p. 52, #3, 7, 11, 15, 21, 29, 33