

# Describing Transformations of Polynomial Functions

You can transform graphs of polynomial functions in the same way you transformed graphs of linear functions, absolute value functions, and quadratic functions. Examples of transformations of the graph of  $f(x) = x^4$  are shown below.

## Core Concept

Transformation	$f(x)$ Notation	Examples
<b>Horizontal Translation</b> Graph shifts left or right.	$f(x - h)$	$g(x) = (x - 5)^4$ 5 units right <i>Add to each x</i> $g(x) = (x + 2)^4$ 2 units left <i>subtract from each x</i>
<b>Vertical Translation</b> Graph shifts up or down.	$f(x) + k$	$g(x) = x^4 + 1$ 1 unit up <i>Add to y</i> $g(x) = x^4 - 4$ 4 units down <i>subtract from y</i>
<b>Reflection</b> Graph flips over $x$ - or $y$ -axis.	$f(-x)$ $-f(x)$	$g(x) = (-x)^4 = x^4$ over $y$ -axis <i>Change sign of x</i> $g(x) = -x^4$ over $x$ -axis <i>change sign of y</i>
<b>Horizontal Stretch or Shrink</b> Graph stretches away from or shrinks toward $y$ -axis.	$f(ax)$	$g(x) = (2x)^4$ shrink by a factor of $\frac{1}{2}$ $g(x) = (\frac{1}{2}x)^4$ stretch by a factor of 2 <i>} multiply x by factor</i>
<b>Vertical Stretch or Shrink</b> Graph stretches away from or shrinks toward $x$ -axis.	$a \circ f(x)$	$g(x) = 8x^4$ stretch by a factor of 8 $g(x) = \frac{1}{4}x^4$ shrink by a factor of $\frac{1}{4}$ <i>} multiply y by factor</i>