Transformation of functions

By subtracting, adding, or multiplying by positive or negative numbers, we can transform graphs.

Example 1

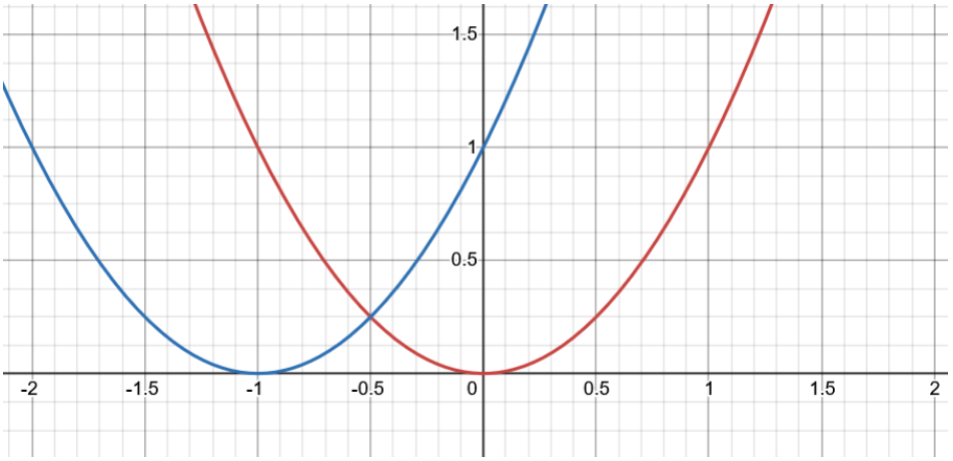
Draw $f(x) = x^2$ and $g(x) = (x+1)^2$ on the same axes.

$f(x)$

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

$g(x)$

x	−2	-1	0	1	2
y	1	0	1	4	9



https://www.desmos.com/calculator/5twzfxm4w4

Red is $f(x)$, blue is $g(x)$

We can see that $g(x)$ is a horizontal translation of $f(x)$ of -1.

Example 2

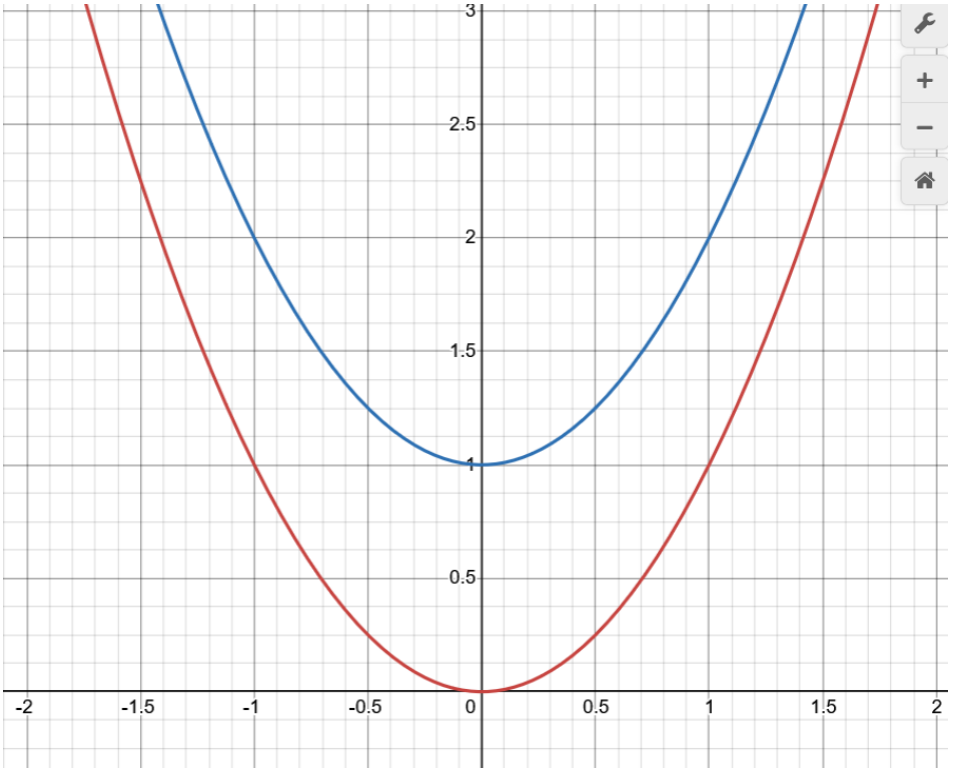
Draw $f(x) = x^2$ and $g(x) = x^2 + 1$ on the same axes.

$f(x)$

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

$g(x)$

x	-2	-1	0	1	2
y	5	2	1	2	5



https://www.desmos.com/calculator/vxea0iwojp

Red is $f(x)$, blue is $g(x)$

We can see that $g(x)$ is a vertical translation of +1 of $f(x)$.

Example 3

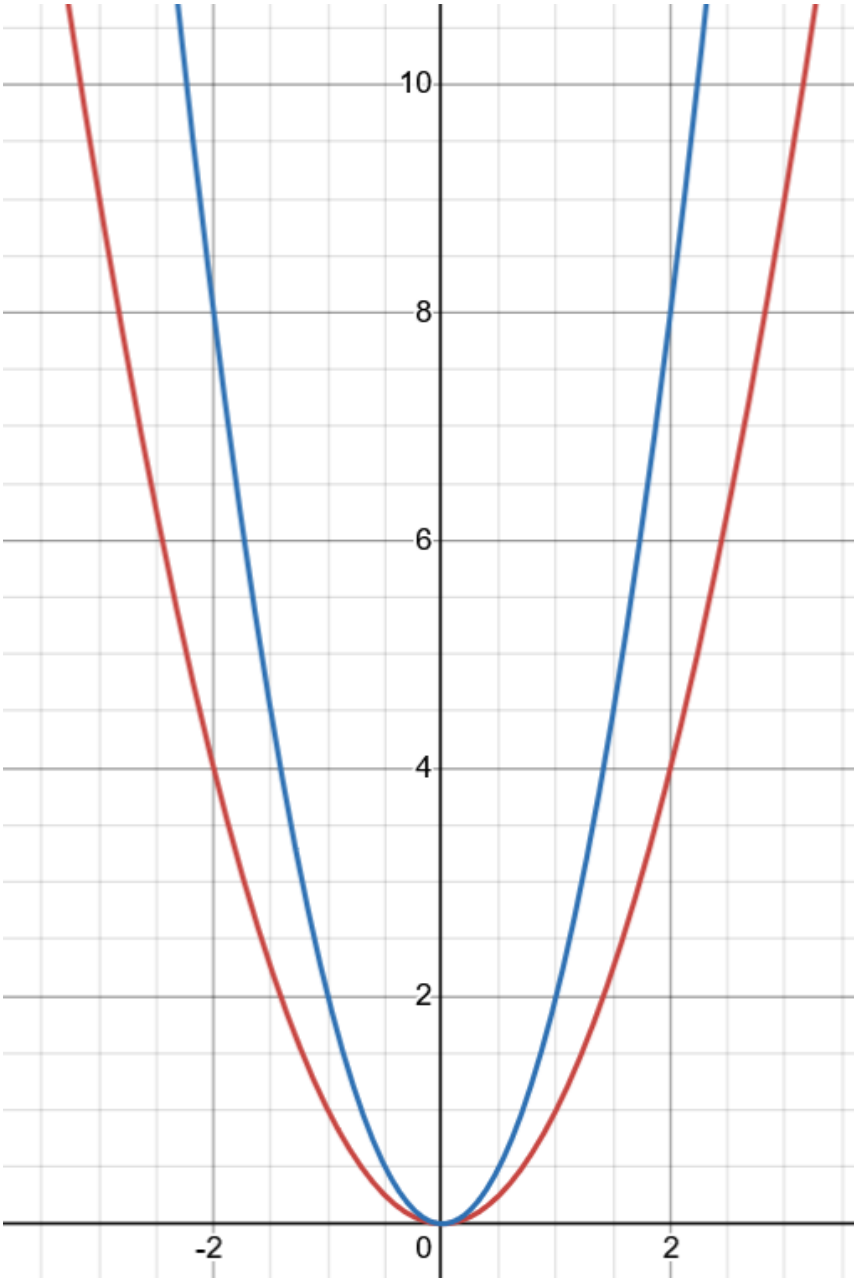
Draw the graph of $f(x) = x^2$ and $g(x) = 2x^2$ on the same axes.

$f(x)$

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

$g(x)$

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



https://www.desmos.com/calculator/5jwql9tnok

Red is $f(x)$ and blue is $g(x)$.

We can see that $g(x)$ is a horizontal stretch of $\frac{1}{2}$ of $f(x)$. The graph has been stretched(in this case half) horizontally.

Pro tip

For any function $f(x) = (ax + b)^2 + c$, a determines the stretch which is $\frac{1}{a}$, b is the horizontal translation, and c is the vertical translation.