

# L3 - Stretches

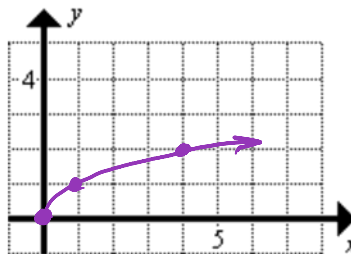
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**Unit 6: Transformations**  
**Lesson 3 - Stretches of Functions**

Ex. 1: Consider the following function:

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

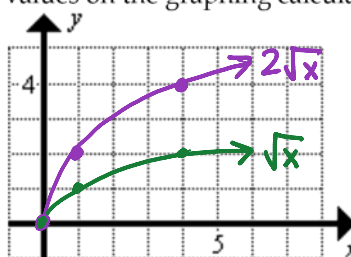
x	y



Graph the indicated function using the table of values on the graphing calculator:

a)  $y = 2f(x) = 2\sqrt{x}$

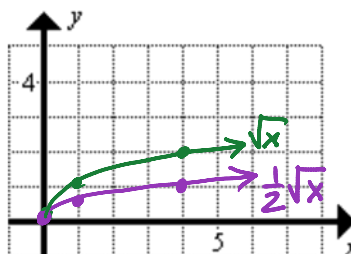
- Change!  
 • y values doubled!  
 • Vertical Expansion (VE)



x	y

b)  $y = \frac{1}{2}f(x) = \frac{1}{2}\sqrt{x}$

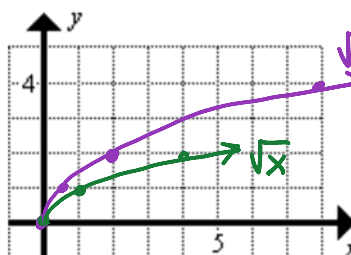
- Change!  
 • y values halved  
 • Vertical Compression (VC)



x	y

c)  $y = f(2x) = \sqrt{2x}$

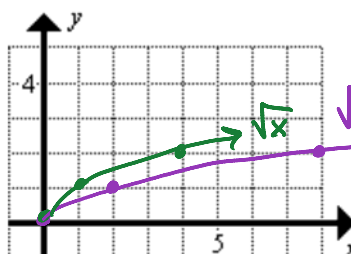
- Change!  
 • x values halved  
 • Horizontal Compression (HC)



x	y

d)  $y = f\left(\frac{1}{2}x\right) = \sqrt{\frac{1}{2}x}$

- Changed?  
 • x values doubled  
 • Horizontal Expansion (HE)



x	y

Observations:

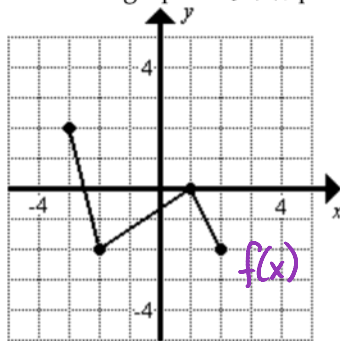
$$y = af(x) \rightarrow \text{Vertical } \begin{cases} \text{Expansion (VE): } |a| > 1 \\ \text{Compression (VC): } |a| < 1 \end{cases}$$

$$y = f(bx) \rightarrow \text{Horizontal } \begin{cases} \text{Expansion (HE): } |b| < 1 \\ \text{Compression (HC): } |b| > 1 \end{cases} \quad \begin{matrix} * \text{opposite} \\ \text{by } \frac{1}{b} \end{matrix}$$

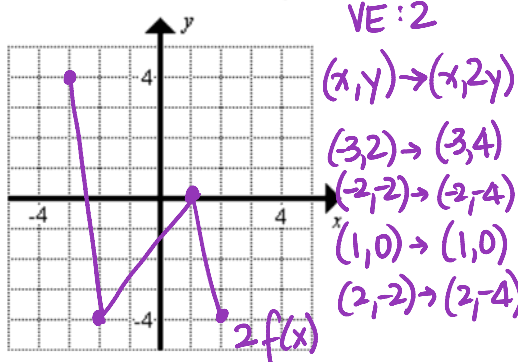
Ex. 2: Using  $y = f(x)$  as a base function, describe the transformation when  $x$  is replaced by  $2x$  and  $y$  is replaced by  $\frac{1}{3}y$  in words and in mapping notation.

$$\begin{aligned} 3 \times \frac{1}{3}y = f(2x) \times 3 & \quad a=3 \rightarrow \text{VE by } 3 \\ y = 3f(2x) & \quad b=2 \rightarrow \text{HC by } \frac{1}{2} \end{aligned} \quad (x,y) \rightarrow \left(\frac{1}{2}x, 3y\right)$$

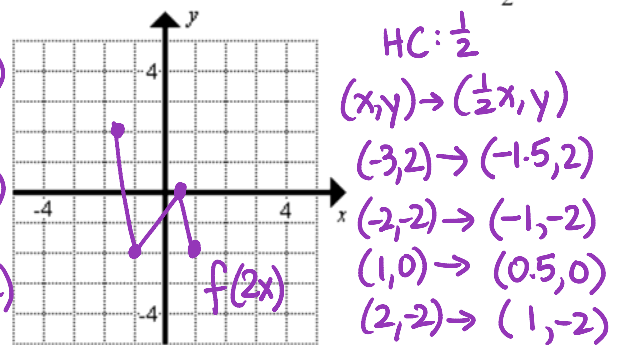
Ex. 3: Given the graph of  $f(x)$ , perform each of the following transformations:



a) a vertical expansion by a factor of 2



b) a horizontal compression by a factor of  $\frac{1}{2}$



Practice: Worksheet H3 – Stretches (use graph paper for any graphs!)