

Precalculus

Lesson 2.5: Graphing Techniques: Transformations

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More Than Meets the Eye

Transformations of Graphs

What we learned in Algebra II,  $y = af(x - h) + k$  may be expanded to include a horizontal stretch or compression and reflections over the  $y$ -axis. From the textbook is the table below:

To Graph:	Draw the Graph of $f$ and:	Functional Change to $f(x)$
<b>Vertical shifts</b>	<i>Happens to output so + means up &amp; - means down</i>	
$y = f(x) + k, k > 0$	Raise the graph of $f$ by $k$ units.	Add $k$ to $f(x)$ .
$y = f(x) - k, k > 0$	Lower the graph of $f$ by $k$ units.	Subtract $k$ from $f(x)$ .
<b>Horizontal shifts</b>	<i>Acts on input. Movement opposite to sign</i>	
$y = f(x + h), h > 0$	Shift the graph of $f$ to the left $h$ units.	Replace $x$ by $x + h$ .
$y = f(x - h), h > 0$	Shift the graph of $f$ to the right $h$ units.	Replace $x$ by $x - h$ .
<b>Compressing or stretching</b>		
$y = af(x), a > 0$	Multiply each $y$ -coordinate of $y = f(x)$ by $a$ .	Multiply $f(x)$ by $a$ .
<i>effects output values stay true</i>	Stretch the graph of $f$ vertically if $a > 1$ .	
	Compress the graph of $f$ vertically if $0 < a < 1$ .	
$y = f(ax), a > 0$	Multiply each $x$ -coordinate of $y = f(x)$ by $\frac{1}{a}$ .	Replace $x$ by $ax$ .
	Stretch the graph of $f$ horizontally if $0 < a < 1$ .	<i>fraction - stretch</i>
	Compress the graph of $f$ horizontally if $a > 1$ .	<i>integer - compress</i>
<b>Reflection about the <math>x</math>-axis</b>		
$y = -f(x)$	Reflect the graph of $f$ about the $x$ -axis.	Multiply $f(x)$ by $-1$ .
<b>Reflection about the <math>y</math>-axis</b>		
$y = f(-x)$	Reflect the graph of $f$ about the $y$ -axis.	Replace $x$ by $-x$ .

**Determine the Function Obtained from a Series of Transformations**

Given the parent function:  $y = |x|$

1. Shift left 2 units 2) Shift up 3 units. 3) Reflected about the y-axis.

#1  $\leftarrow 2$   $y = |x+2|$     #2  $\uparrow 3$   $y = |x+2|+3$     #3  $y = f(-x)$  replace  $x$  with  $-x$

#3  $y = |-x+2|+3$

Write the parent function and include

transformations

**To graph a transformed function:**

- Identify the parent function  $y = \sqrt{x}$
- What is being done to the parent? Consider order of operation

Graph:  $f(x) = \sqrt{1-x} + 2 = \sqrt{-(x-1)} + 2$  ← write in  $f(x-h)$  form

- #1 negative under radical: reflect over y-axis    #2  $(x-1)$  Shift  $\rightarrow 1$  Right    #3  $+2$   $\uparrow 2$

① Parent  $\Rightarrow y = \sqrt{x}$

②  $\rightarrow$

③  $\uparrow 2$

