Name: _____

Date: _____

Period: _____

# Student Workbook

## Transformations of Functions

**Learning Target:** I can describe and graph transformations of parent functions, including shifts, stretches, compressions, and reflections.

## Vocabulary

| Term | Meaning |
|---|---|
| Parent Function | The simplest form of a function family (e.g., $f(x)=x^2$, $f(x)=\sqrt{x}$, $f(x)=\|x\|$). |
| Vertical Shift | Moves the graph up or down: $f(x) + k$. |
| Horizontal Shift | Moves the graph left or right: $f(x - h)$. |
| Stretch/Compression | Makes the graph taller/narrower (stretch) or shorter/wider (compression). |
| Reflection | Flips the graph over the x-axis (if a is negative) or the y-axis (if b is negative). |

## Key Concept: The General Transformation Form

**$g(x) = a \cdot f(b(x - h)) + k$**

| Parameter | Effect |
|---|---|
| a | Vertical stretch ($\|a\|>1$) or compression ($0<\|a\|<1$); reflects over x-axis if $a < 0$ |
| b | Horizontal stretch/compression; reflects over y-axis if $b < 0$ |
| h | Horizontal shift: RIGHT if h is positive, LEFT if h is negative |
| k | Vertical shift: UP if k is positive, DOWN if k is negative |

**COMMON MISTAKE**

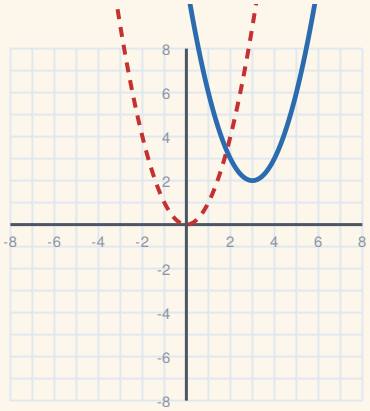
For horizontal shifts, the sign INSIDE the parentheses is opposite of the direction! $(x - 3)$ shifts RIGHT by 3, and $(x + 3)$ shifts LEFT by 3. This trips up almost everyone at first — slow down and double check.

## Worked Examples

### EXAMPLE 1

Parent: $f(x) = x^2$. Graph $g(x) = (x-3)^2 + 2$.

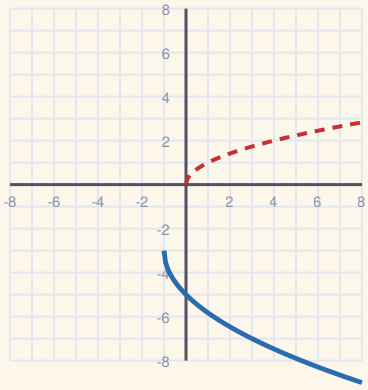
Shift right 3, up 2.




### EXAMPLE 2

Parent: $f(x) = \sqrt{x}$. Graph $g(x) = -2\sqrt{(x+1)} - 3$.

Reflect over x-axis, stretch by 2, shift left 1, down 3.




### EXAMPLE 3 — Write the Equation

The parent function $f(x) = |x|$ is shifted left 4 and reflected over the x-axis. Write the new equation.

$g(x) =$ _____

## Guided Practice — Part A: Describe the Transformations

**A1** $g(x) = (x+2)^2 - 5$ (parent: $x^2$)

**A2** $g(x) = -3|x-1| + 4$ (parent: $|x|$)

**A3** $g(x) = \sqrt{(x-6)} + 1$ (parent: $\sqrt{x}$)

## Guided Practice — Part B: Graph the Transformation (Parent: $x^2$)

**B1** $g(x) = (x-2)^2 + 3$

**B2** $g(x) = -(x+1)^2 + 4$

## Guided Practice — Part C: Graph the Transformation

**C1** $g(x) = \sqrt{(x+3)} - 2$ (parent: $\sqrt{x}$)

**C2** $g(x) = -|x-2| + 5$ (parent: $|x|$)

## Guided Practice — Part D: Write the Equation

**D1** $y = x^2$ shifted left 5 and down 2.

**D2** $y = |x|$ reflected over the x-axis and shifted up 3.

**BEFORE YOU MOVE ON**

Check with a partner: for horizontal shifts, did you use the OPPOSITE sign of what's inside the parentheses?