

# Expressing Transformations of Functions Algebraically

Let's express transformed functions algebraically.



### **Describing Translations**

Let  $g(x) = \sqrt{x}$ . Complete the table. Be prepared to explain your reasoning.

words (the graph of $y = g(x)$ is)	function notation	expression
translated left 5 units	g(x+5)	
translated left 5 units and down 3 units		$\sqrt{x+5}-3$
	g(-x)	$\sqrt{-x}$
translated left 5 units, then down 3 units, then reflected across the <i>y</i> -axis		



### 7.2

#### **Info Gap: Transforming Functions**

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.

If If your teacher gives you the problem card:

- 1. Silently read your card and think about what information you need to answer the question.
- Ask your partner for the specific information that you need. "Can you tell me ?"
- 3. Explain to your partner how you are using the information to solve the problem. "I need to know \_\_\_\_\_\_because \_\_\_\_\_."
- 4. Continue to ask questions until you have enough information to solve the problem.
- 5. Once you have enough information, share the problem card with your partner, and solve the problem independently.
- 6. Read the data card, and discuss your reasoning.

If your teacher gives you the data card:

- 1. Silently read your card. Wait for your partner to ask for information.
- Before telling your partner any information, ask, "Why do you need to know \_\_\_\_\_?"
- 3. Listen to your partner's reasoning and ask clarifying questions. Only give information that is on your card. Do not figure out anything for your partner!
- 4. These steps may be repeated.
- Once your partner says they have enough information to solve the problem, read the problem card, and solve the problem independently.
- 6. Share the data card, and discuss your reasoning.



## 7.3 Translating Vertex Form

Let f be the function given by  $f(x) = x^2$ .

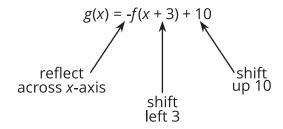
- 1. Write an equation for the function g whose graph is the graph of f translated 3 units left and up 5 units.
- 2. What is the vertex of the graph of *g*? Explain how you know.

- 3. Write an equation for a quadratic function h whose graph has a vertex at (1.5, 2.6).
- 4. Write an equation for a quadratic function k whose graph opens downward and has a vertex at (3.2, -4.7).



#### Lesson 7 Summary

You can use the equation of a function to write an equation for its transformation. For example, let  $f(x) = x^2$ . Take the graph of f, reflect it across the x-axis, translate it up 10 units, and translate it left 3 units. What is an equation for this new function? The new function g is related to f by g(x) = -f(x+3) + 10, since



Which means  $g(x) = -(x + 3)^2 + 10$ .

Sometimes you can recognize from the expression for a function that it is the transformation of a simpler function. For example, consider:

$$H(t) = 10 - (1.2)^{t+5}$$

One way to obtain the expression for H from  $1.2^t$  is:

- adding 5 to the input to get  $(1.2)^{t+5}$
- multiplying the output by -1 to get  $-(1.2)^{t+5}$
- adding 10 to the output to get  $10 (1.2)^{t+5}$

So the graph of H is obtained from the graph of  $f(t)=1.2^t$  by translating left 5 units, reflecting across the x-axis, and translating up 10 units. Consider the point (0,1) on the graph of f. After translating, reflecting, and translating again, it becomes the point (-5,9) on the graph of H.

