

## Activity 1: Explore Patterns in Functions

### Part I

Graph the following functions in Desmos. Sketch or copy/paste the graphs below. How are the graphs of these three functions related?

$$f(x) = x^2$$

$$f(x) = x^2 + 5$$

$$f(x) = x^2 - 3$$

Now consider the functions below. The first function is called the **parent function**. Describe the pattern: how does the value of  $c$  in each function impact the graph of the parent function?

$$f(x) = x^2$$

$$f(x) = x^2 + c$$

$$f(x) = x^2 - c$$

### Part II

Graph the following functions in Desmos. Sketch or copy/paste the graphs below. How are the graphs of these three functions related?

$$f(x) = x^2$$

$$f(x) = (x + 5)^2$$

$$f(x) = (x - 3)^2$$

Now consider the functions below. The first function is called the **parent function**. Describe the pattern: how does the value of  $c$  in each function impact the graph of the parent function?

$$f(x) = x^2$$

$$f(x) = (x + c)^2$$

$$f(x) = (x - c)^2$$

### Part III

Graph the following functions in Desmos. Sketch or copy/paste the graphs below. How are the graphs of these two functions related?

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

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

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

Now consider the functions below. The first function is called the **parent function**. Describe the pattern: how is the graph of the second function related to the graph of the parent function? Brainstorm *why* this relationship exists.

$$y = f(x)$$

$$y = -f(x)$$

$$y = f(-x)$$

### Part IV

Graph the following functions. How are the graphs of the functions related? Can you write a general statement that explains what is going on?

$$f(x) = x^2$$

$$f(x) = 2x^2$$

$$f(x) = \frac{1}{2}x^2$$

Now consider the functions below. The first function is called the **parent function**. Describe the pattern: how does the value of  $c$  in each function impact the graph of the parent function?

$$y = f(x)$$

$$y = c \cdot f(x), \quad c > 0$$

$$y = c \cdot f(x), \quad 0 < c < 1$$

## Part V

Graph the following functions. How are the graphs of the functions related? Can you write a general statement that explains what is going on?

$$f(x) = x^2$$

$$f(x) = (2x)^2$$

$$f(x) = \left(\frac{1}{2}x\right)^2$$

Now consider the functions below. The first function is called the **parent function**. Describe the pattern: how does the value of  $c$  in each function impact the graph of the parent function?

$$y = f(x)$$

$$y = f(cx), \quad c > 0$$

$$y = f(cx), \quad 0 < c < 1$$

## Together: Recap the Patterns as Transformations

In Part I – Part V, you explored **patterns** in functions. These patterns result in **transformations** of the functions. How would you define a **transformation**?

Given  $f(x)$ , what kind of **transformation** is:

$$f(x) + c$$

$$f(x) - c$$

$$f(x + c)$$

$$f(x - c)$$

$$-f(x)$$

$$f(-x)$$

$$c \cdot f(x) \text{ if } c > 1$$

$$c \cdot f(x) \text{ if } 0 < c < 1$$

$$f(c \cdot x) \text{ if } c > 1$$

$$f(c \cdot x) \text{ if } 0 < c < 1$$