

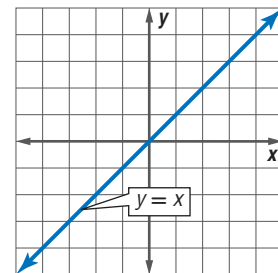
# Graphing Technology Lab

## The Family of Linear Graphs

A family of people is related by birth, marriage, or adoption. Often people in families share characteristics. The graphs in a family share at least one characteristic. Graphs in the linear family are all lines, with the simplest graph in the family being that of the parent function  $y = x$ .

You can use a graphing calculator to investigate how changing the parameters  $m$  and  $b$  in  $y = mx + b$  affects the graphs in the family of linear functions.

Parent Graph



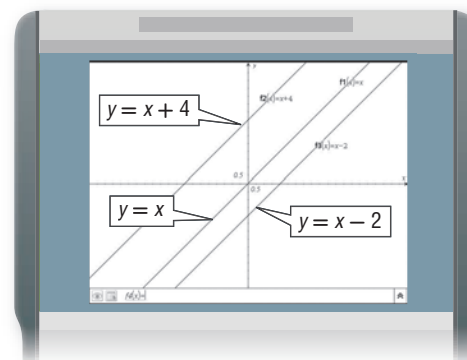
### ACTIVITY 1 Changing $b$ in $y = mx + b$

Graph  $y = x$ ,  $y = x + 4$ , and  $y = x - 2$  in the standard viewing window.

Enter the equations in the Y= list as Y1, Y2, and Y3. Then graph the equations.

**KEYSTROKES:** Review graphing in your textbook.

- How do the slopes of the graphs compare?
- Compare the graph of  $y = x + 4$  and the graph of  $y = x$ . How would you obtain the graph of  $y = x + 4$  from the graph of  $y = x$ ?
- How would you obtain the graph of  $y = x - 2$  from the graph of  $y = x$ ?



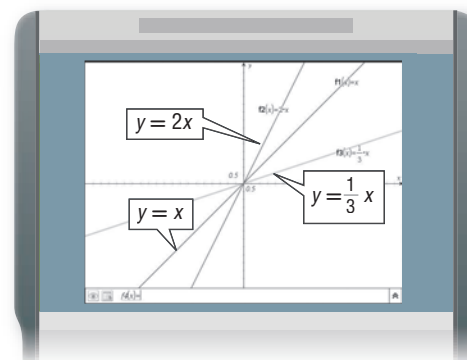
Changing  $m$  in  $y = mx + b$  affects the graphs in a different way than changing  $b$ . First, investigate positive values of  $m$ .

### ACTIVITY 2 Changing $m$ in $y = mx + b$ , Positive Values

Graph  $y = x$ ,  $y = 2x$ , and  $y = \frac{1}{3}x$  in the standard viewing window.

Enter the equations in the Y= list and graph.

- How do the  $y$ -intercepts of the graphs compare?
- Compare the graph of  $y = 2x$  and the graph of  $y = x$ .
- Which is steeper, the graph of  $y = \frac{1}{3}x$  or the graph of  $y = x$ ?



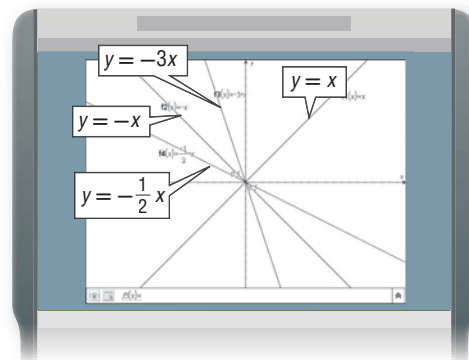
Does changing  $m$  to a negative value affect the graph differently than changing it to a positive value?

### ACTIVITY 3 Changing $m$ in $y = mx + b$ , Negative Values

Graph  $y = x$ ,  $y = -x$ ,  $y = -3x$ , and  $y = -\frac{1}{2}x$  in the standard viewing window.

Enter the equations in the Y= list and graph.

- 3A.** How are the graphs with negative values of  $m$  different than graphs with a positive  $m$ ?
- 3B.** Compare the graphs of  $y = -x$ ,  $y = -3x$ , and  $y = -\frac{1}{2}x$ . Which is steepest?



### Analyze the Results

Graph each set of equations on the same screen. Describe the similarities or differences among the graphs.

- $y = 2x$   
 $y = 2x + 3$   
 $y = 2x - 7$
  - $y = x + 1$   
 $y = 2x + 1$   
 $y = \frac{1}{4}x + 1$
  - $y = x + 4$   
 $y = 2x + 4$   
 $y = \frac{3}{4}x + 4$
  - $y = 0.5x + 2$   
 $y = 0.5x - 5$   
 $y = 0.5x + 4$
  - $y = -2x - 2$   
 $y = -4.2x - 2$   
 $y = -\frac{1}{3}x - 2$
  - $y = 3x$   
 $y = 3x + 6$   
 $y = 3x - 7$
- 7.** Families of graphs have common characteristics. What do the graphs of all equations of the form  $y = mx + b$  have in common?
- 8.** How does the value of  $b$  affect the graph of  $y = mx + b$ ?
- 9.** What is the result of changing the value of  $m$  on the graph of  $y = mx + b$  if  $m$  is positive?
- 10.** How can you determine which graph is steepest by examining the following equations?  
 $y = 3x$ ,  $y = -4x - 7$ ,  $y = \frac{1}{2}x + 4$
- 11.** Explain how knowing about the effects of  $m$  and  $b$  can help you sketch the graph of an equation.
- 12.** The equation  $y = k$  can also be a parent graph. Graph  $y = 5$ ,  $y = 2$ , and  $y = -4$  on the same screen. Describe the similarities or differences among the graphs.

### Extension

Nonlinear functions can also be defined in terms of a family of graphs. Graph each set of equations on the same screen. Describe the similarities or differences among the graphs.

- $y = x^2$   
 $y = -3x^2$   
 $y = (-3x)^2$
  - $y = x^2$   
 $y = x^2 + 3$   
 $y = (x - 2)^2$
  - $y = x^2$   
 $y = 2x^2 + 4$   
 $y = (3x)^2 - 5$
- 16.** Describe the similarities and differences in the classes of functions  $f(x) = x^2 + c$  and  $f(x) = (x + c)^2$ , where  $c$  is any real number.