

Graphing Technology Lab

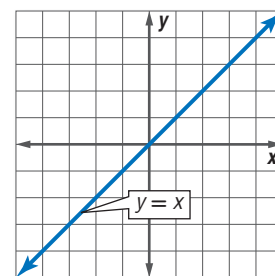
The Family of Linear Graphs

Sharp EL-9900C

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



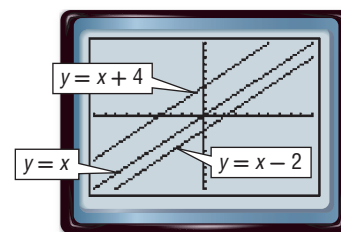
ACTIVITY 1 Changing b in $y = mx + b$

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: $Y=$ $X/\theta/T/n$ ENTER $X/\theta/T/n$ $+$ 4 ENTER
 $X/\theta/T/n$ $-$ 2 Zoom \blacktriangleright 5

- 1A. How do the slopes of the graphs compare?
- 1B. 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 $y = x$?
- 1C. 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 .

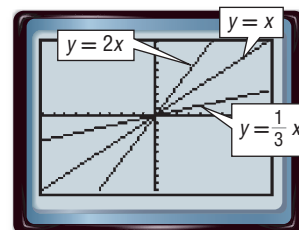
ACTIVITY 2 Changing m in $y = mx + b$, Positive Values

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.

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

KEYSTROKES: $Y=$ CL $X/\theta/T/n$ ENTER 2 $X/\theta/T/n$ ENTER
 1 a/b 3 $X/\theta/T/n$ Zoom \blacktriangleright 5



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

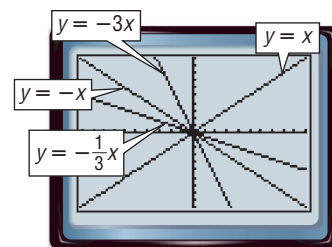
ACTIVITY 3 Changing m in $y = mx + b$, Negative Values

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.

- $y = 2x$
 $y = 2x + 3$
 $y = 2x - 7$
- $y = x + 1$
 $y = 2x + 1$
 $y = \frac{1}{4}x + 1$
- $y = x + 4$
 $y = 2x + 4$
 $y = \frac{3}{4}x + 4$
- $y = 0.5x + 2$
 $y = 0.5x - 5$
 $y = 0.5x + 4$
- $y = -2x - 2$
 $y = -4.2x - 2$
 $y = -\frac{1}{3}x - 2$
- $y = 3x$
 $y = 3x + 6$
 $y = 3x - 7$
- Families of graphs have common characteristics. What do the graphs of all equations of the form $y = mx + b$ have in common?
- How does the value of b affect the graph of $y = mx + b$?
- What is the result of changing the value of m on the graph of $y = mx + b$ if m is positive?
- How can you determine which graph is steepest by examining the following equations?
 $y = 3x$, $y = -4x - 7$, $y = \frac{1}{2}x + 4$
- Explain how knowing about the effects of m and b can help you sketch the graph of an equation.
- 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.

- $y = x^2$
 $y = -3x^2$
 $y = (-3x)^2$
- $y = x^2$
 $y = x^2 + 3$
 $y = (x - 2)^2$
- $y = x^2$
 $y = 2x^2 + 4$
 $y = (3x)^2 - 5$
- 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.