

The Family of Linear Graphs

A family of people is a group related by birth, marriage, or adoption. Recall that a *family of graphs* includes graphs with at least one characteristic in common.

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.



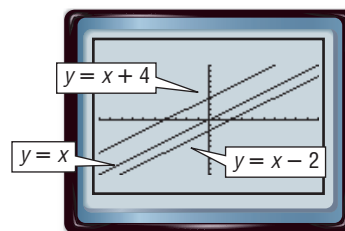
ACTIVITY 1 Changing b in $y = mx + b$

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.

- 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 $y = x$?



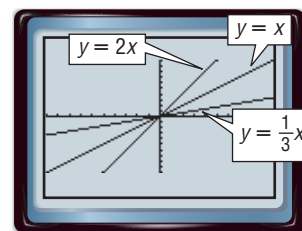
Changing m in $y = mx + b$ affects the graphs in a different way than changing b . First, investigate positive values of m .

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 graphs of $y = 2x$ and $y = x$.
- 2C. 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?

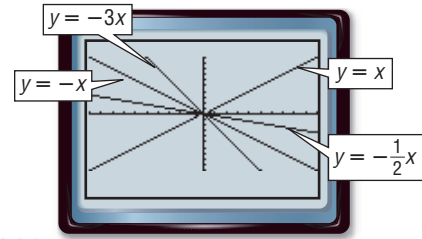
ACTIVITY 3 Changing m in $y = mx + b$, Negative Values

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.

1. $y = 2x$

$y = 2x + 3$

$y = 2x - 7$

2. $y = x + 1$

$y = 2x + 1$

$y = \frac{1}{4}x + 1$

3. $y = x + 4$

$y = 2x + 4$

$y = 0.75x - 4$

4. $y = \frac{1}{2}x + 2$

$y = \frac{1}{2}x - 5$

$y = \frac{1}{2}x + 4$

5. $y = -2x - 2$

$y = -4x - 2$

$y = -\frac{1}{3}x - 2$

6. $y = 3x$

$y = 3x + 6$

$y = 3x - 7$

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? if m is negative?

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.

Nonlinear functions can also be defined in terms of a family of graphs.

The **absolute value function** is $y = |x|$, where $y \geq 0$ for all values of x .

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

12. $y = |x|$

$y = -3|x|$

$y = |-3x|$

13. $y = |x|$

$y = |x| + 3$

$y = |x| - 2$

14. $y = |x|$

$y = |2x| + 4$

$y = 3|x| - 5$

15. Describe the similarities and differences in the classes of functions $f(x) = |x| + c$ and $f(x) = |x + c|$, where c is any real number.