LESSON 1

Objective

Graph linear equations; recognize a nonlinear equation.

Common Core State Standards

- **8.F.3** Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*

Functions

Graphing Linear Equations

A linear function is commonly expressed as a linear equation of the form $y = mx + b$. Students learn to graph linear equations by substituting values for x into the equation, finding the corresponding y values, plotting the x-y pairs on a grid, and drawing a line through the points. Students also should know that many functions are not linear and should recognize the characteristics of nonlinear equations.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *When choosing values of* x *to substitute into an equation, why is it a good idea to choose at least one positive value, one negative value, and zero?*
- **Ask:** *Is it easier to see if (–3, –4) is a solution to $y = 2x + 2$ by using the graph or by using the table?* Have students explain their responses.
- Have students plot points on their pegboards for the equation $y = x^2 - 3$, using the values $x = -3, -2, -1, 0, 1, 2,$ and 3. Elicit that the points do not lie on a straight line; the graph is a curve. Note that squaring x is what makes the equation nonlinear. Explain that a linear equation never has x or y raised to a power other than 1. Discuss examples.

Solve It

Reread the problem with students. Have students write a paragraph describing their graphs, focusing on the directions of the graphs, where the graphs intersect each axis, and how close the graphs are to the origin.

More Ideas

For another way to teach about graphing linear equations—

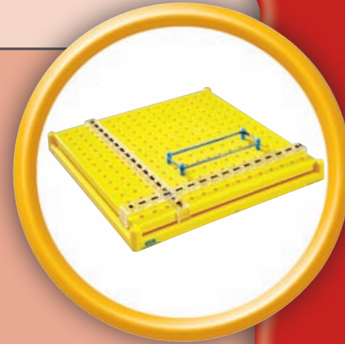
- Have students use pegboards to graph $y = 3x$, $y = x \div 3$, $y = x + 3$, and $y = x - 3$. Ask students to transfer each graph to a separate transparency. Overlay the graphs on an overhead projector and have students compare the graphs.

Formative Assessment

Have students try the following problem.

Which ordered pair is a solution to the linear equation $y = x + 6$?

A. (1, 6) **B.** (1, 7) **C.** (6, 1) **D.** (7, 1)



Try It! 30 minutes | Pairs

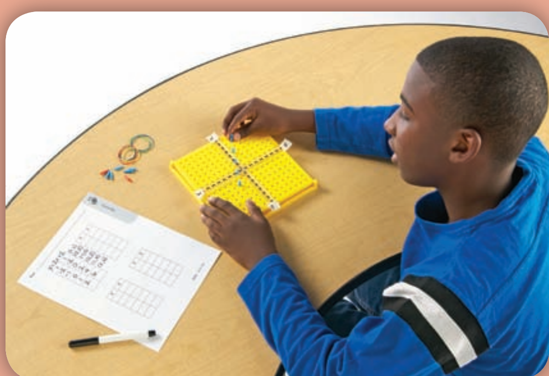
Here is a problem about graphing linear equations.

Two hikers are finding their way to camp. There are two trails they could follow. One trail can be mapped on a four-quadrant grid using the equation $y = 2x + 2$. The other trail can be mapped using the equation $y = x + 3$. If camp is located at the origin, which trail will take the hikers closer to camp?

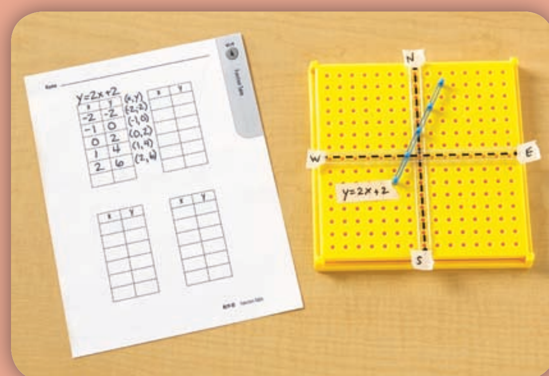
Introduce the problem. Then have students do the activity to solve the problem. Distribute the materials. Ask students to set up their pegboards for 4-quadrant graphing. Have them use masking tape to label the *x*-axis East on the right and West on the left and the *y*-axis North at the top and South at the bottom.

Materials

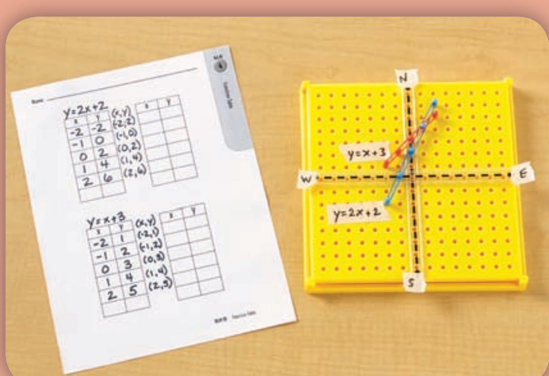
- XY Coordinate Pegboard
- Function Tables (BLM 4; 1 per pair)
- masking tape (1 six-inch strip per pair)



1. Have students write $y = 2x + 2$ at the top of the first table and fill in the *x* column with the values –2, –1, 0, 1, and 2. **Say:** *Substitute each value of* x *into the equation and find the corresponding value of* y. *Record the value. Then use the two values to write an ordered pair next to the table. Plot the ordered pairs on the pegboard.*



2. Ask: *Do the pegs appear to form a straight line?* Elicit that the graph for a *linear equation* is a straight line. Have students stretch a rubber band from the peg at (–2, –2) to the peg at (2, 6). Ask them to label the line $y = 2x + 2$ using a piece of masking tape.



3. Guide students through the process once again as they graph $y = x + 3$. Have students describe each graph and then compare the two graphs. **Ask:** *Does either graph pass through the origin? Is there any point that is on both graphs?*

⚠ Look Out!

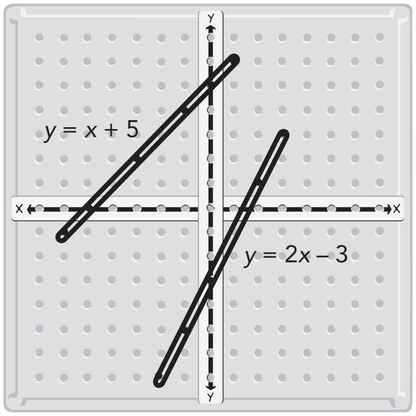
Some students might confuse the *x*- and *y*-coordinates or the *x*- and *y*-axes. Remind them that the ordered pair is arranged in alphabetical order so the *x*-coordinate is listed first.

Answer Key

Use an XY Coordinate Pegboard to graph each line. Make a table of ordered pairs for each line.

(Check students' work.)

1.



$y = x + 5$

x	1	0	–1	–3	–5
y	6	5	4	2	0

$y = 2x - 3$

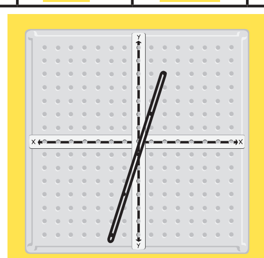
x	3	2	0	–1	–2
y	3	1	–3	–5	–7

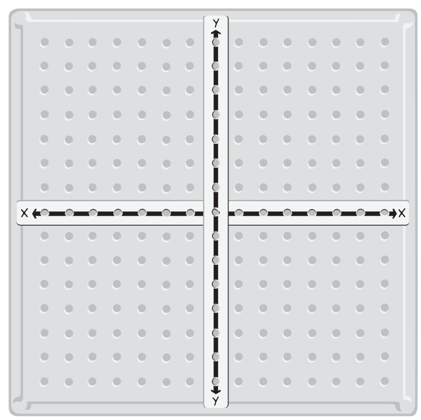
Using an XY Coordinate Pegboard, graph the line on a coordinate plane. Make a table of ordered pairs for the line.

(Check students' models.)

2. $y = 3x - 1$

x	2	1	0	–1	–2
y	5	2	–1	–4	–7





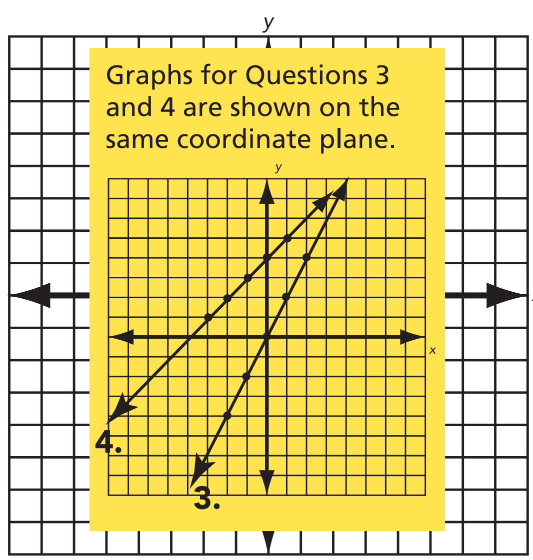
Make a table of ordered pairs for each equation. Graph and label each line on the coordinate plane.

3. $y = 2x$

x	2	1	0	–1	–2
y	4	2	0	–2	–4

4. $y = x + 4$

x	1	0	–1	–2	–3
y	5	4	3	2	1



Answer Key

Challenge! Use the equations $y = x - 1$ and $y = x^2 - 3$ to show how two points can be on the graph of a linear equation and also on the graph of a nonlinear equation.

Challenge: Students should generate points for both equations, graph the line and the curve, and note that the points (–1, –2) and (2, 1) are on both graphs.

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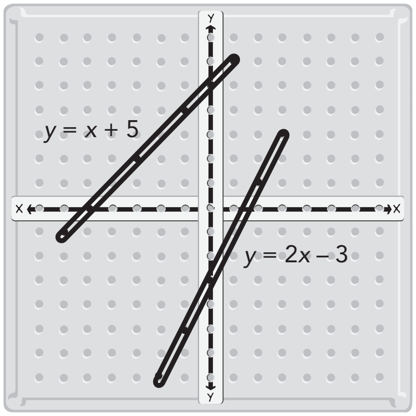
**Use an XY Coordinate Pegboard to graph each line.
Make a table of ordered pairs for each line.**

1.



$y = x + 5$

x					
y					

$y = 2x - 3$

x					
y					

Using an XY Coordinate Pegboard, graph the line on a coordinate plane. Make a table of ordered pairs for the line.

2. $y = 3x - 1$

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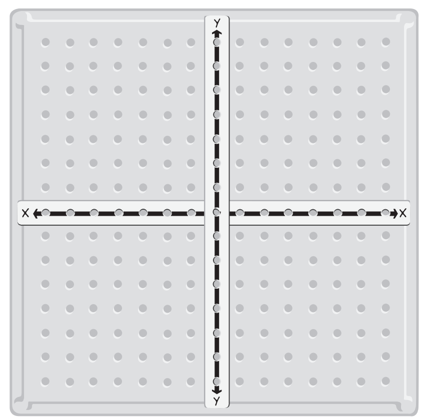
y					



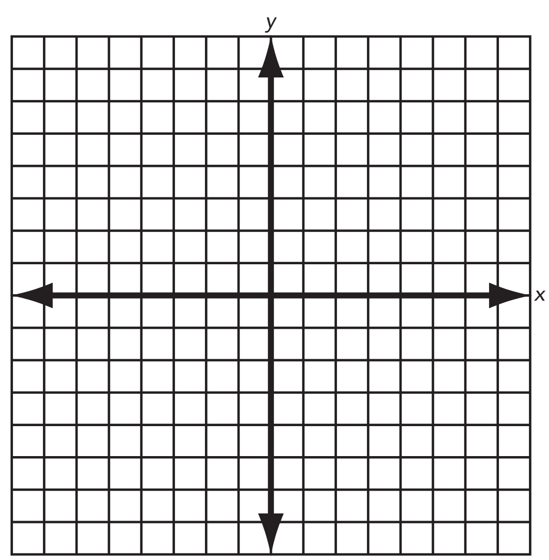
Make a table of ordered pairs for each equation. Graph and label each line on the coordinate plane.

3. $y = 2x$

x					
y					

4. $y = x + 4$

x					
y					



Name ___________________________________

Challenge! Use the equations $y = x - 1$ and $y = x^2 - 3$ to show how two points can be on the graph of a linear equation and also on the graph of a nonlinear equation.

Name ______________________________

x	y

x	y

x	y

x	y