

# Constant Rate of Change

## What You'll Learn

Scan the lesson. Write the definitions of linear relationships and constant rate of change.

- linear relationships - relationships that show a straight line on a graph
- constant rate of change - the consistent change between the y's & x's

## Essential Question

WHY are graphs helpful?

## Vocabulary

linear relationship  
constant rate of change

## Common Core State Standards

Content Standards  
Preparation for 8.EE.5  
Mathematical Practices  
1, 3, 4, 5

## Real-World Link

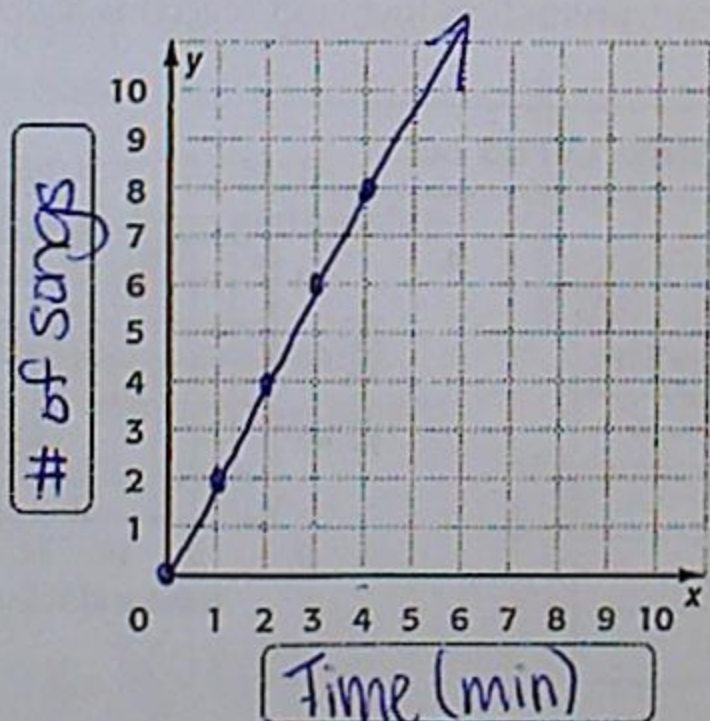
**Music** Marcus can download two songs from the Internet each minute. This is shown in the table below.

Time (minutes), $x$	0	1	2	3	4
Number of Songs, $y$	0	2	4	6	8

1. Compare the change in the number of songs  $y$  to the change in time  $x$ . What is the rate of change?

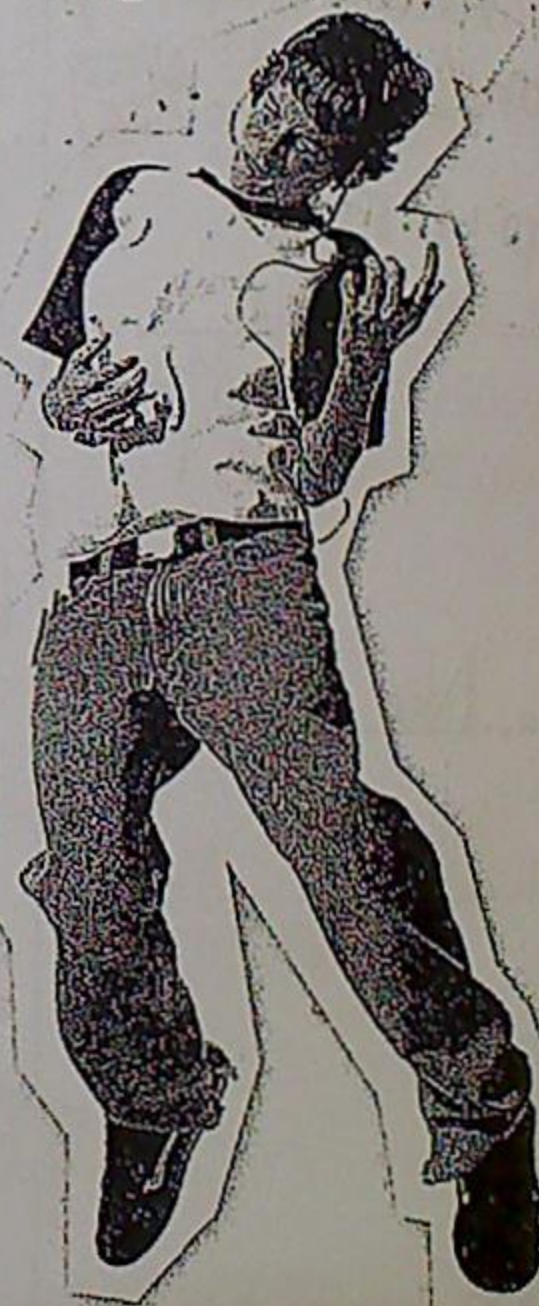
$\frac{2}{1}$  2 songs per minute

2. Graph the ordered pairs from the table on the graph shown. Label the axes. Then describe the pattern shown on the graph.



- (0,0)
- (1,2)
- (2,4)
- (3,6)
- (4,8)

It increases, change in  $y$  is twice that of  $x$



BRING THIS WEDNESDAY!

# Linear Relationships

Relationships that have straight-line graphs, like the one on the previous page, are called linear relationships. Notice that as the number of songs increases by 2, the time in minutes increases by 1.

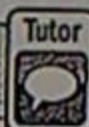
Number of Songs, $y$	0	2	4	6	8
Time (minutes), $x$	0	1	2	3	4

$\overset{+2}{\curvearrowright}$   $\overset{+2}{\curvearrowright}$   $\overset{+2}{\curvearrowright}$   $\overset{+2}{\curvearrowright}$   
 $\underset{+1}{\curvearrowright}$   $\underset{+1}{\curvearrowright}$   $\underset{+1}{\curvearrowright}$   $\underset{+1}{\curvearrowright}$

**Rate of Change**  
 $\frac{2}{1} = 2$  songs per minute

The rate of change between any two points in a linear relationship is the same or *constant*. A linear relationship has a constant rate of change.

## Example



- The balance in an account after several transactions is shown. Is the relationship between the balance and number of transactions linear? If so, find the constant rate of change. If not, explain your reasoning.

Number of Transactions	Balance (\$) $y$
3	170
6	140
9	110
12	80

$\left. \begin{matrix} +3 \\ +3 \\ +3 \end{matrix} \right\}$   $\left. \begin{matrix} -30 \\ -30 \\ -30 \end{matrix} \right\}$

As the number of transactions increases by 3, the balance in the account decreases by \$30.

$$\frac{y}{x} = \frac{-30}{3} \div \frac{3}{3} = \frac{-10}{1}$$

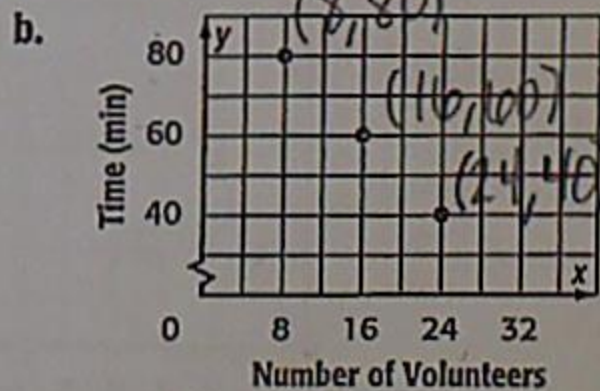
Since the rate of change is constant, this is a linear relationship. The constant rate of change is  $\frac{-30}{3}$  or  $-\$10$  per transaction. This means that each transaction involved a \$10 *withdrawal*.

**Got It?** Do these problems to find out.

a.

Cooling Water	
Time $x$ (min)	Temperature $y$ ( $^{\circ}$ F)
5	95
10	90
15	86
20	82

$\left. \begin{matrix} +5 \\ +5 \\ +5 \end{matrix} \right\}$   $\left. \begin{matrix} -5 \\ -4 \\ -4 \end{matrix} \right\}$



$\left. \begin{matrix} (8, 80) \\ (16, 60) \\ (24, 40) \end{matrix} \right\}$   $\left. \begin{matrix} -20 \\ -20 \end{matrix} \right\}$   
 $\frac{-20}{8} = -2.5$   
 $\frac{-20}{8} = -2.5$

Finding Rate of Change:

$$\frac{\text{change in } y}{\text{change in } x}$$

Step 1: Find how much your  $y$  value

changes.

Step 2: Find how much your  $x$  value

changes.

Step 3: Create a fraction out of these 2 #s ( $y$  value on top,  $x$  on bottom)



Step 4: Find the unit rate. \*want the bottom number to be 1

a. No

b. Yes, -2.5 min per volunteer