

# Constant Rate of Change

## What You'll Learn

Scan the text on the following two pages. Write two facts you learned about constant rate of change.

- **Sample answer: Constant rates of change can be shown using a table.**
- **Sample answer: Constant rates of change can be shown using a graph.**



## Essential Question

HOW can you show that two objects are proportional?



## Vocabulary

rate of change  
constant rate of change



## Common Core State Standards

### Content Standards

7.RP.2, 7.RP.2b, 7.RP.2d

### Mathematical Practices

1, 3, 4

## Vocabulary Start-Up



A **rate of change** is a rate that describes how one quantity changes in relation to another. In a linear relationship, the rate of change between any two quantities is the same. A linear relationship has a **constant rate of change**.



## Real-World Link

A computer programmer charges customers per line of code written. Fill in the blanks with the amount of change between consecutive numbers.

Lines of Code	50	100	150	200
Cost (\$)	1,000	2,000	3,000	4,000

$+50$     $+50$     $+50$   
 $+1,000$     $+1,000$     $+1,000$

Label the diagram below with the terms *change in lines*, *change in dollars*, and *constant rate of change*.

$$\frac{\text{change in dollars}}{\text{change in lines}} = \frac{\$1,000}{50 \text{ lines}}$$

$$= \frac{\$20}{1 \text{ line}} \left. \vphantom{\frac{\$20}{1 \text{ line}}}\right\} \text{unit rate}$$

The **constant rate of change** is \$20 per line of programming code.



## Use a Table

You can use a table to find a constant rate of change.



## Example



1. The table shows the amount of money a booster club makes washing cars for a fundraiser. Use the information to find the constant rate of change in dollars per car.

Cars Washed	
Number	Money (\$)
5	40
10	80
15	120
20	160

+5 ↻ (next to 5, 10, 15)  
 +40 ↻ (next to 40, 80, 120, 160)

Find the unit rate to determine the constant rate of change.

$$\frac{\text{change in money}}{\text{change in cars}} = \frac{40 \text{ dollars}}{5 \text{ cars}} \quad \text{The money earned increases by \$40 for every 5 cars.}$$

$$= \frac{8 \text{ dollars}}{1 \text{ car}} \quad \text{Write as a unit rate.}$$

So, the number of dollars earned increases by \$8 for every car washed.

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

- a. The table shows the number of miles a plane traveled while in flight. Use the information to find the approximate constant rate of change in miles per minute.

Time (min)	30	60	90	120
Distance (mi)	290	580	870	1,160

- b. The table shows the number of students that buses can transport. Use the table to find the constant rate of change in students per school bus.

Number of Buses	2	3	4	5
Number of Students	144	216	288	360

## Unit Rate

A rate of change is usually expressed as a unit rate.



a. about 10 miles per minute

b. 72 students per school bus



## Use a Graph

You can also use a graph to find a constant rate of change and to analyze points on the graph.



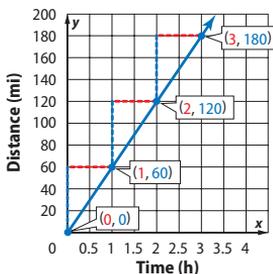
### Examples



- 2. The graph represents the distance traveled while driving on a highway. Find the constant rate of change.**

To find the rate of change, pick any two points on the line, such as  $(0, 0)$  and  $(1, 60)$ .

$$\begin{aligned} \frac{\text{change in miles}}{\text{change in hours}} &= \frac{(60 - 0) \text{ miles}}{(1 - 0) \text{ hours}} \\ &= \frac{60 \text{ miles}}{1 \text{ hour}} \end{aligned}$$



### Ordered Pairs

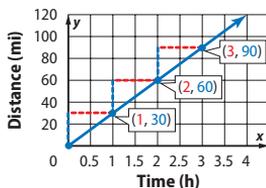
The ordered pair  $(2, 120)$  represents traveling 120 miles in 2 hours.

- 3. Explain what the points  $(0, 0)$  and  $(1, 60)$  represent.**

The point  $(0, 0)$  represents traveling zero miles in zero hours. The point  $(1, 60)$  represents traveling 60 miles in 1 hour. Notice that this is the constant rate of change.

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

- c. Use the graph to find the constant rate of change in miles per hour while driving in the city.
- d. On the lines below, explain what the points  $(0, 0)$  and  $(1, 30)$  represent.



Show your work.

c. 30 miles per hour

**The point  $(0, 0)$  represents traveling zero miles in zero hours.**

**The point  $(1, 30)$  represents traveling 30 miles in 1 hour.**



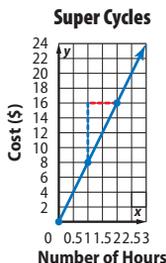
## Example



4. The table and graph below show the hourly charge to rent a bicycle at two different stores. Which store charges more per bicycle? Explain.

Pedals Rentals	
Time (hour)	Cost (\$)
2	24
3	36
4	48

+1 (Time) and +12 (Cost) are indicated for the intervals between rows.



The cost at Pedals Rentals increases by \$12 every hour. The cost at Super Cycles increases by \$8 every hour.

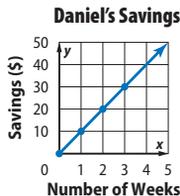
So, Pedals Rentals charges more per hour to rent a bicycle.

## Guided Practice



1. The table and graph below show the amount of money Mi-Ling and Daniel save each week. Who saves more each week? Explain. (Examples 1, 2, and 4)

Mi-Ling's Savings	
Time (weeks)	Savings (\$)
2	\$30
3	\$45
4	\$60

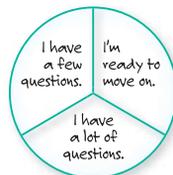


**Mi-Ling; The unit rate for Mi-Ling's savings is \$15 per week. The unit rate for Daniel's savings is \$10 per week.**

2. Refer to the graph in Exercise 1. Explain what the points (0, 0) and (1, 10) represent. (Example 3)  
**(0, 0) represents zero dollars saved by Daniel in zero weeks. (1, 10) represents 10 dollars saved in one week.**
3. **Building on the Essential Question** How can you find the unit rate on a graph that goes through the origin? **Sample answer: Use the y-coordinate of the point where the x-coordinate is 1.**

### Rate Yourself!

Are you ready to move on?  
Shade the section that applies.



For more help, go online to access a Personal Tutor.

