

# Compare Functions

## Use What You Know

You have learned to identify a function. Take a look at this problem.

Today was a snow day. Felicia decided to track the snowfall. There were already 2 inches of snow on the ground from a previous storm. Felicia measured the snow from today's storm at the end of each hour. She found that exactly 1.5 inches of snow fell each hour. If it snowed at this rate for 5 hours, how much snow was on the ground at the end of each hour?

Use the math you already know to solve the problem.

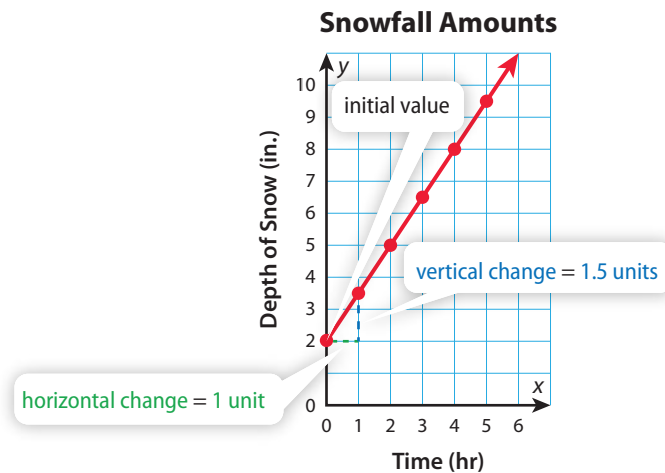
Time ( $h$ )	0	1	2	3	4	5
Depth of Snow (in.)	2					

- a. In the table, 0 represents the time when the storm started. How much snow was on the ground then? \_\_\_\_\_
- b. How much snow fell in the first hour? \_\_\_\_\_ So, how much snow was on the ground when Felicia measured it at the end of the first hour? Show how you got your answer.
- \_\_\_\_\_
- \_\_\_\_\_
- c. Describe how you can use addition to find the depth of the snow at the end of each hour. Then complete the table. \_\_\_\_\_
- \_\_\_\_\_
- d. Suppose you multiply each hour in the table by the rate 1.5 inches per hour. What else do you have to do to find the total depth of the snow?
- \_\_\_\_\_
- e. Fill in the blanks to write an equation for the situation. Let  $s$  equal the depth of the snow in inches and  $h$  equal the hour.  $s =$  \_\_\_\_\_  $+$  \_\_\_\_\_  $\cdot h$

## Find Out More

You are familiar with proportional relationships that start at  $(0, 0)$ . For example, 0 hours worked means 0 dollars earned. The problem on the previous page does not include  $(0, 0)$ . The problem states that there were already 2 inches of snow on the ground at 0 hours. This function starts at  $(0, 2)$ , so the **initial value**, or starting output value, is 2.

Let's look at a graph of this function.



The graph also shows the **rate of change**. The  $x$ -values and  $y$ -values change at different rates, but the ratio of these changes is always the same. From point to point the  $y$ -values change by 1.5 units and the  $x$ -values change by 1 unit. So, the rate of change is  $\frac{1.5}{1}$ , or 1.5. You will discover later on in the lesson that functions can have many different initial values and rates of change.

## Reflect

- 1 Dora opened a savings account and deposited \$50. When she gets her paycheck each week, Dora will put \$25 into the savings account. Describe the initial value and rate of change for this situation. \_\_\_\_\_

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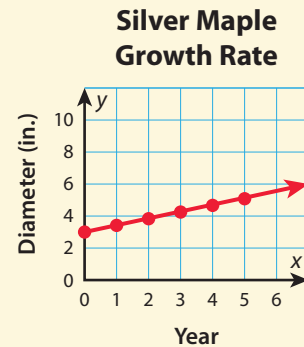
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# Learn About Interpreting and Comparing Rates of Change

Read the problem below. Then explore different ways to compare rates of change.

A biologist studied the growth of two different trees over a five-year period. At the beginning of the study, she measured each tree's diameter. The biologist took this same measurement each year to determine the growth.

The red maple in her study had a starting diameter of 4 inches. The diameter grew at an average rate of 0.3 inches per year. The graph on the right shows the growth rate of the silver maple tree. Which function has a greater rate of change?

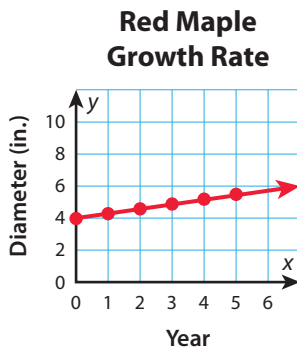


 **Graph It** You can use a graph to show the rate of change for the red maple tree.

Make a table of values. At the beginning of the study (year 0) the diameter of the red maple tree is 4 inches. Its diameter grows at a rate of 0.3 inches each year.

Year	0	1	2	3	4	5
Diameter of Tree	4	4.3	4.6	4.9	5.2	5.5

Use the values in the table to make a graph.



**Connect It** Use the graphs to compare the rates of change for both functions.

2 Write ordered pairs for the points that show the initial value on each graph.

Silver Maple: \_\_\_\_\_ Red Maple: \_\_\_\_\_

What do the initial values represent in this problem? \_\_\_\_\_

\_\_\_\_\_

3 Fill in the blanks to describe the rate of change for both functions.

On the red maple graph, the  $\frac{\text{vertical change}}{\text{horizontal change}}$  is  $\frac{0.3}{1}$ .

On the silver maple graph, the  $\frac{\text{vertical change}}{\text{horizontal change}}$  is \_\_\_\_\_.

4 What do the rates of change represent in the problem? \_\_\_\_\_

\_\_\_\_\_

5 Which function has a greater rate of change? What does that mean in this context?

\_\_\_\_\_

\_\_\_\_\_

**Try It** Use what you just learned to solve this problem. Show your work on a separate sheet of paper.

6 The table and graph show how much money a store earns selling each team T-shirt and each team cap. Compare the rates of change for these two functions.

\_\_\_\_\_

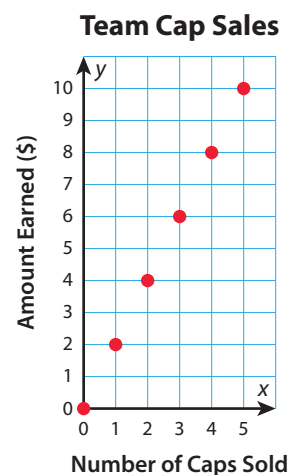
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\_\_\_\_\_

\_\_\_\_\_

Number of T-shirts Sold	Amount Earned (\$)
1	4
2	8
3	12
4	16



# Learn About Interpreting and Comparing Functions

Read the problem below. Then explore different ways to compare functions.

Mrs. White buys a used car for \$3,000. She makes monthly payments of \$300 until the car is paid for.

Mr. Brown also buys a used car. His monthly payment plan is shown in the table.

Month	0	1	2	3	4	5	6	7	8
Amount Mr. Brown Owes (\$)	2,400	2,100	1,800	1,500	1,200	900	600	300	0

Find and compare the rate of change and initial value for each function.

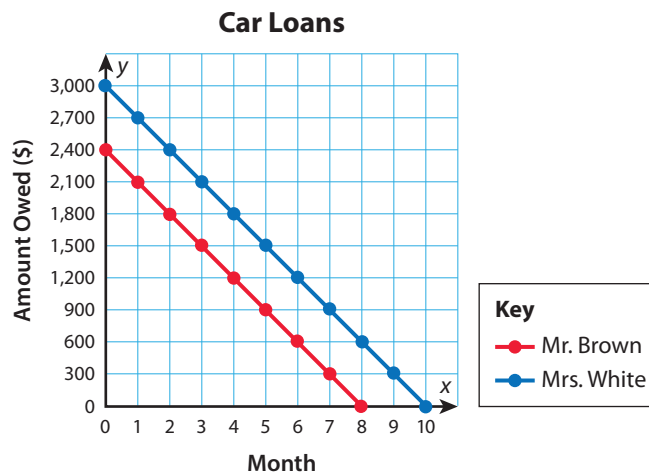
**Model It** You can create a table of values for Mrs. White’s plan to compare functions.

Her total bill is \$3,000, and the monthly payment is \$300. The amount owed will continue to decrease by \$300.

Month	0	1	2	3	4	5	6	7	8	9	10
Amount Mrs. White Owes (\$)	3,000	2,700	2,400	2,100	1,800	1,500	1,200	900	600	300	0

**Graph It** You can plot ordered pairs on the same coordinate grid to compare the functions.

For each function, as the  $x$ -values increase, the  $y$ -values decrease. This shows a negative rate of change.



**Connect It** Now you can analyze the tables and graphs to compare the functions.

**7** Look at the tables on the previous page.

By how much does the amount Mr. Brown owes decrease each month? \_\_\_\_\_

By how much does the amount Mrs. White owes decrease each month? \_\_\_\_\_

**8** What does your answer to problem 7 tell you about the rates of change for these functions? How does the graph show this? \_\_\_\_\_

\_\_\_\_\_

**9** What is the initial value for each function? What do the initial values mean in the context of the problem? \_\_\_\_\_

\_\_\_\_\_

**10** Fill in the blanks to write an equation for each function, where  $x$  = number of months and  $y$  = amount owed. Mrs. White's plan: \_\_\_\_\_

Mr. Brown's plan: \_\_\_\_\_

**11** Does it take the same time to finish paying for the car with both plans? Explain why or why not by describing the rate of change and initial values. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Try It** Use what you just learned to solve this problem. Show your work on a separate sheet of paper.

**12** Below are two companies' rates for textbook rentals. What is the initial value for each function? What is the cost to rent a textbook for 4 months from each company?

**Company A:**  $c = 15m + 15$ , where  $c$  = total cost in dollars and  $m$  = number of months

**Company B:** \$19 per month per textbook

\_\_\_\_\_

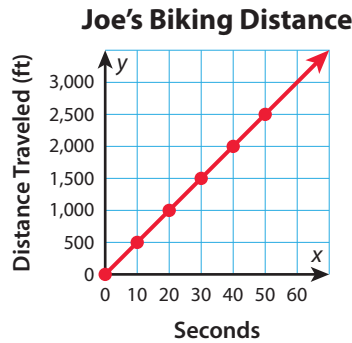
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# Practice Interpreting and Comparing Functions

Study the example below. Then solve problems 13–15.

## Example

Justin and Joe are biking downhill. Justin starts 500 feet ahead of Joe and travels at a rate of 44 feet per second. Joe's rate is shown in the graph. After 1 minute, who will be farther down the hill?



Look at how you could show your work.

The graph shows that in 60 seconds (1 min), Joe travels 3,000 ft.

Justin's distance in 1 min is  $44 \text{ ft/s} \times 60 \text{ s}$ , or 2,640 ft.

Add Justin's head start:  $2,640 + 500 = 3,140 \text{ ft}$

**Solution** Justin will be 140 feet ahead of Joe after 1 minute of biking.



The student used the graph to determine Joe's rate. The rates can be used to find the total distance for any time.

### Pair/Share

Can you solve this problem in a different way?

- 13** The equation and table show what two boys pay for gym fees. Compare the rate of change and initial value for each function.

#### Alfredo

Month	0	1	2	3
Cost (\$)	20	30	40	50

#### Alex

$c = 25 + 10m$ , where  
 $c$  = cost in dollars and  
 $m$  = number of months.



What do the parts of the equation represent?

Show your work.

**Solution** \_\_\_\_\_

\_\_\_\_\_

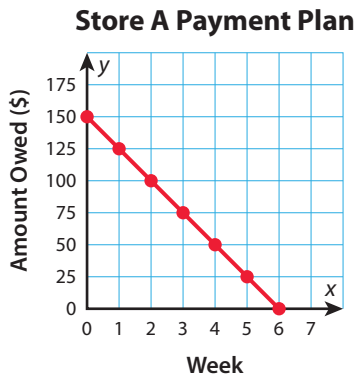
### Pair/Share

How much more will Alex's cost be each month? Why?

- 14 Roy wants to buy a new wireless phone for \$200. Two stores offer different payment options. Which plan has a greater initial value? Which phone will be paid for at a faster rate?



How does the graph show the initial value?



**Store B Payment Plan**

Pay \$50 at the time of purchase. Pay \$20 per week until the phone is paid for.

Show your work.

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**Solution**

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**Pair/Share**

Which option will take longer to pay? How much longer?

- 15 Which statement about these equations is true?

Equation A:  $y = 3x + 4$

Equation B:  $y = 5x + 2$

- A Equation A has a greater rate of change.
- B Equation A has a greater initial value.
- C Equation B has a greater initial value.
- D Both equations have the same initial value.



How does an equation show the initial value?

Ben chose C as the correct answer. How did he get that answer?

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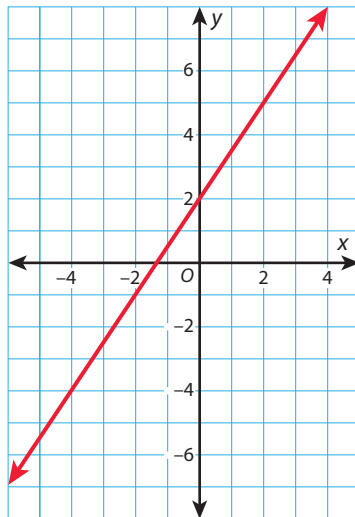
**Pair/Share**

How would the graphs of the equations compare?



**Practice**  **Interpreting and Comparing Functions****Solve the problems.**

- 1** The graph shows a function.



Which equation represents a function with a rate of change that is less than the rate of change of the function shown in the graph?

- A**  $y = 2x - 4$
- B**  $y = \frac{5}{3}x + 1$
- C**  $y = \frac{3}{2}x - 1$
- D**  $y = x + 3$
- 2** For each verbal description, write an equation that represents the situation.

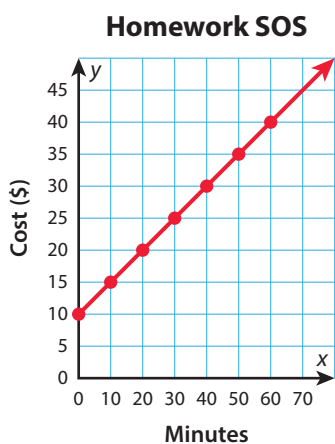
Samantha begins her road trip with 30 gallons of gasoline in the tank of her van. Her van gets 25 miles to the gallon. Let  $y$  represent the number of gallons of gasoline in the tank after  $x$  miles of travel.

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Evan has a cell phone plan that costs \$30 per month and \$0.25 per minute of phone use. Let  $y$  represent the monthly cost of cell phone service after  $x$  minutes of phone use.

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3 The rates for two homework help services are shown below.



**Homework Lifeline**

**Rates for Our Services**

- Pay \$25 to set up an account with our service.
- Then pay \$0.40 for each minute of homework assistance that you receive.

Which service has the greater rate of change? Which has a greater initial value? Describe what this means in the context of the problem.

**Show your work.**

**Answer** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

What would be the total cost for setting up an account and receiving 90 minutes of homework assistance at each company?

**Show your work.**

**Answer** \_\_\_\_\_  
\_\_\_\_\_

**Self Check** Go back and see what you can check off on the Self Check on page 51.