

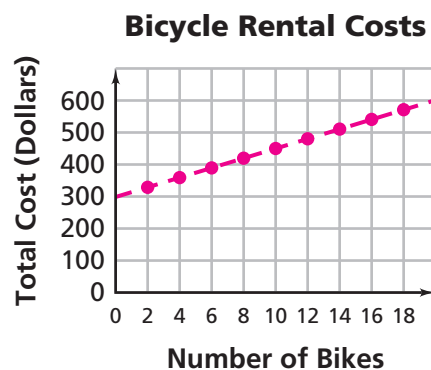
Investigation

1

Walking Rates

In *Variables and Patterns*, you read about a bicycle touring business. You used tables, graphs, and equations to represent patterns relating variables such as cost, income, and profit. You looked at some linear relationships, like the relationship between cost and number of rental bikes represented in this graph:

Relationships that are represented by straight lines on a graph are called **linear relationships** or **linear functions**. From the graph, you see that the relationship between the number of bikes rented and the total rental cost is a linear function. In this investigation, you will consider the questions:



How can you determine whether a relationship is linear by examining a table of data or an equation?

How do changes in one variable affect changes in a related variable? How are these changes captured in a table, a graph, or an equation?

1.1 Walking Marathons

Ms. Chang's class decides to participate in a walkathon. Each participant must find sponsors to pledge a certain amount of money for each kilometer the participant walks. Leanne suggests that they determine their walking rates in meters per second so they can make predictions.

Do you know what your walking rate is?



Problem 1.1 Finding and Using Rates

To determine your walking rate:

- Line up ten meter sticks, end to end (or mark off 100 meters), in the hall of your school.
 - Have a partner time your walk.
 - Start at one end and walk the length of the ten meter sticks using your normal walking pace.
- A.** What is your walking rate in meters per second?
- B.** Assume you continue to walk at this constant rate.
1. How long would it take you to walk 500 meters?
 2. How far could you walk in 30 seconds? In 10 minutes? In 1 hour?
 3. Describe in words the distance in meters you could walk in a given number of seconds.
 4. Write an equation that represents the distance d in meters that you could walk in t seconds if you maintain this pace.
 5. Use the equation to predict the distance you would walk in 45 seconds.



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1.2 Walking Rates and Linear Relationships

Think about the effect a walking rate has on the relationship between time walked and distance walked. This will provide some important clues about how to identify linear relationships from tables, graphs, and equations.

Problem 1.2 Linear Relationships in Tables, Graphs, and Equations

Here are the walking rates that Gilberto, Alana, and Leanne found in their experiment.

Name	Walking Rate
Alana	1 meter per second
Gilberto	2 meters per second
Leanne	2.5 meters per second

- A.**
1. Make a table showing the distance walked by each student for the first ten seconds. How does the walking rate affect the data?
 2. Graph the time and distance on the same coordinate axes. Use a different color for each student's data. How does the walking rate affect the graph?
 3. Write an equation that gives the relationship between the time t and the distance d walked for each student. How is the walking rate represented in the equations?
- B.** For each student:
1. If t increases by 1 second, by how much does the distance change? How is this change represented in a table? In a graph?
 2. If t increases by 5 seconds, by how much does the distance change? How is this change represented in a table? In a graph?
 3. What is the walking rate per minute? The walking rate per hour?
- C.** Four other friends who are part of the walkathon made the following representations of their data. Are any of these relationships linear relationships? Explain.

George's Walking Rate

Time (seconds)	Distance (meters)
0	0
1	2
2	9
3	11
4	20
5	25

Elizabeth's Walking Rate

Time (seconds)	Distance (meters)
0	0
2	3
4	6
6	9
8	12
10	15

Billie's Walking Rate
 $D = 2.25t$
D represents distance
t represents time

Bob's Walking Rate
 $t = \frac{100}{r}$
t represents time
r represents walking rate

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Problem 1.3 Using Linear Relationships

- A.**
1. Make a table for each student's pledge plan, showing the amount of money each of his or her sponsors would owe if he or she walked distances from 0 to 6 kilometers. What are the dependent and independent variables?
 2. Graph the three pledge plans on the same coordinate axes. Use a different color for each plan.
 3. Write an equation for each pledge plan. Explain what information each number and variable in your equation represents.
 4. **a.** What pattern of change for each pledge plan do you observe in the table?
b. How does this pattern appear in the graph? In the equation?
- B.**
1. Suppose each student walks 8 kilometers in the walkathon. How much money does each sponsor owe?
 2. Suppose each student receives \$10 from a sponsor. How many kilometers does each student walk?
 3. On which graph does the point (12, 11) lie? What information does this point represent?
 4. In Alana's plan, how is the fixed \$5 donation represented in
a. the table? **b.** the graph? **c.** the equation?
- C.** Gilberto decides to give a T-shirt to each of his sponsors. Each shirt costs him \$4.75. He plans to pay for each shirt with some of the money he collects from each sponsor.
1. Write an equation that represents the amount of money Gilberto makes from each sponsor after he has paid for the T-shirts. Explain what information each number and variable in the equation represents.
 2. Graph the equation for distances from 0 to 5 kilometers.
 3. Compare this graph to the graph of Gilberto's pledge plan in Question A, part (2).

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1.4 Using the Walkathon Money

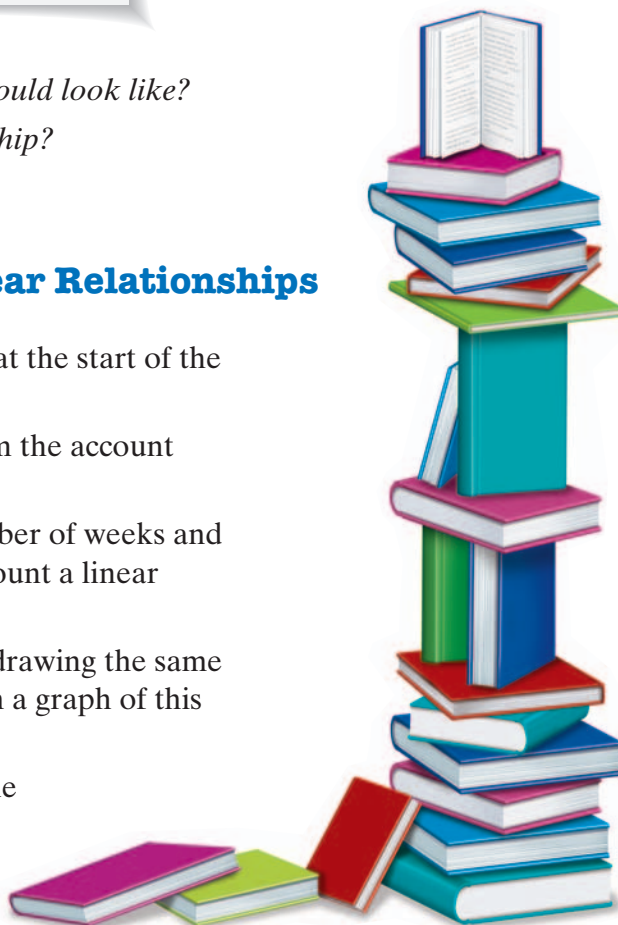
Ms. Chang's class decides to use their money from the walkathon to provide books for the children's ward at the hospital. They put the money in the school safe and withdraw a fixed amount each week to buy new books. To keep track of the money, Isabella makes a table of the amount of money in the account at the end of each week.

Week	Amount of Money at the End of Each Week
0	\$144
1	\$132
2	\$120
3	\$108
4	\$96
5	\$84

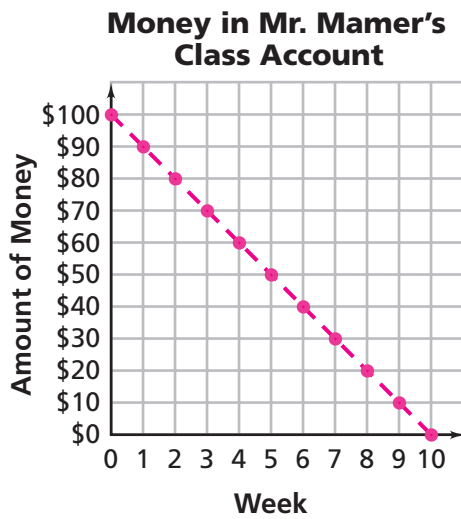
*What do you think the graph would look like?
Is this a linear relationship?*

Problem 1.4 Recognizing Linear Relationships

- A. **1.** How much money is in the account at the start of the project?
- 2.** How much money is withdrawn from the account each week?
- 3.** Is the relationship between the number of weeks and the amount of money left in the account a linear relationship? Explain.
- 4.** Suppose the students continue withdrawing the same amount of money each week. Sketch a graph of this relationship.
- 5.** Write an equation that represents the relationship. Explain what information each number and variable represents.



- B.** Mr. Mamer’s class also raised money from the walkathon. They use their money to buy games and puzzles for the children’s ward. Sade uses a graph to keep track of the amount of money in their account at the end of each week.



1. What information does the graph represent about the money in Mr. Mamer’s class account?
 2. Make a table of data for the first 10 weeks. Explain why the table represents a linear relationship.
 3. Write an equation that represents the linear relationship. Explain what information each number and variable represents.
- C.** How can you determine if a relationship is linear from a graph, table, or equation?
- D.** Compare the linear relationships in this problem with those in previous problems in this investigation.

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