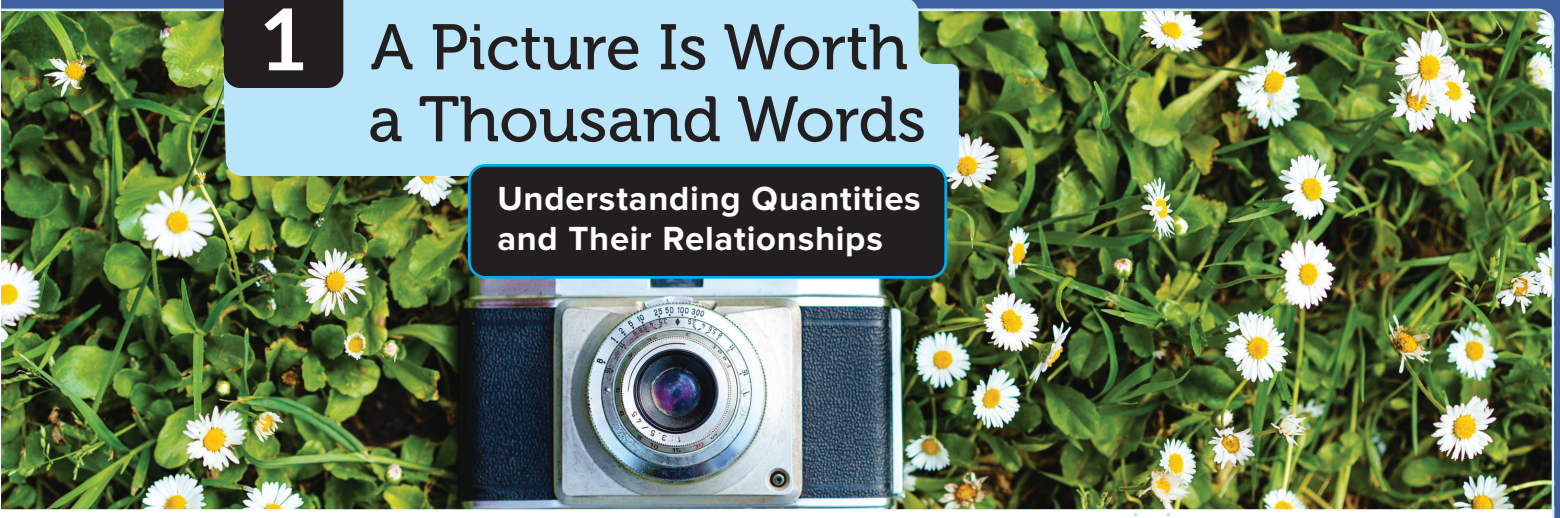
LESSON 1

A Picture Is Worth a Thousand Words

Understanding Quantities and Their Relationships



My Learning Goals

- I can use a reasonable scale for a graph modeling a situation.
- I can identify the independent and dependent quantities for a situation.
- I can identify key characteristics of graphs.

California High School

Big Ideas

Function Investigations
Features of Functions

Number and Quantity Standards

Quantities

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ★
2. Define appropriate quantities for the purpose of descriptive modeling. ★

Functions Standard

Interpreting Functions

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ★

Make a Connection

You have analyzed graphs of relationships and identified important features such as intercepts and slopes.

Learning Prompt

How can the key characteristics of a graph tell a story?

Activate What Comes First?

Consider the situation and quantity pairs shared by your teacher. Prepare to share your thinking with your classmates.

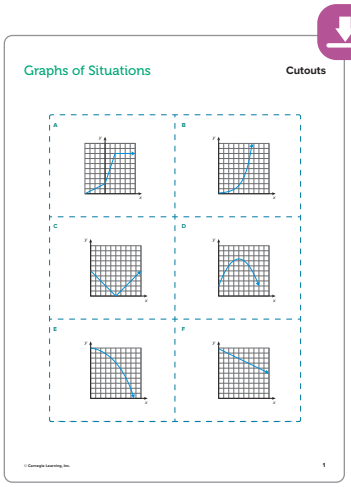
Explore and Develop | Activity 1

Connecting Situations and Their Graphs

Habits of Mind SMP

- Model with mathematics.
- Use appropriate tools strategically.

Graphs relay information about relationships in a visual way. You can use lines or smooth curves to represent relationships between points on a graph. In some problem situations, all the points on the line will make sense. In other problem situations, not all the points will make sense. So, when you model a relationship with a line or a curve, it is up to you to consider the situation and interpret the meaning of the data values.



Cut out the graphs provided by your teacher. Then, read each of the six situations in this activity.

- Determine the independent and dependent quantities.
- Match each situation to its corresponding graph. Glue the graph next to the situation.
- For each graph, label the *x*- and *y*-axis with the appropriate quantity and a reasonable scale, and then interpret the meaning of the origin.

1 Daredevil Graph E

Jared completes a dive from a cliff 100-feet above a river. It takes him only 1.7 seconds to hit the water.

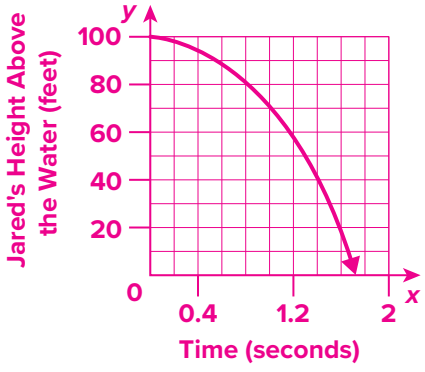
- Independent quantity:

  Time (seconds)

- Dependent quantity:

  Jared's height above the water (feet)

  Origin: (0 seconds, 0 feet above the water)



Think About . . .

Be sure to include the appropriate units of measure for each quantity.

Ask Yourself . . .

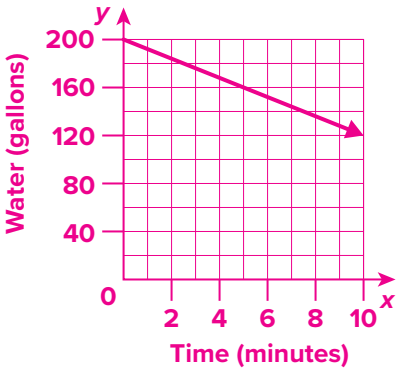
What strategies will you use to match each graph with one of the six situations?

2 Something's Fishy Graph F

Parker is cleaning a 200-gallon office aquarium. She removes the fish and drains the water at a constant rate of 10 gallons per minute.

- Independent quantity:
  Time (minutes)
- Dependent quantity:
  Water (gallons)

  Origin: (0 minutes, 0 gallons of water)

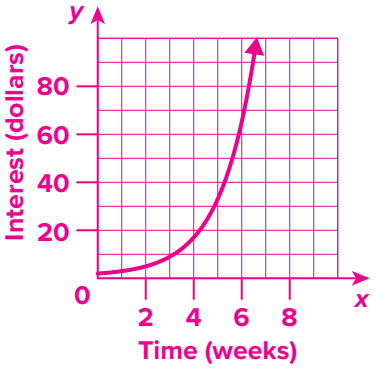


3 Smart Phone, But Is It a Smart Deal? Graph B

You want an upgraded smartphone but lack the funds. Your cousin offers to lend you the money with interest, starting at $1 and doubling weekly. You wonder if it's a good deal.

- Independent quantity:
  Time (weeks)
- Dependent quantity:
  Interest (dollars)

  Origin: (0 weeks, 0 dollars of interest)

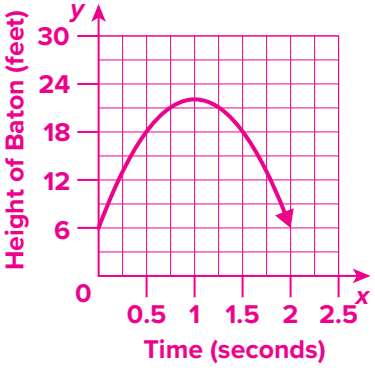


4 Baton Twirling Graph D

Juniper, the Altadena High drum major, tosses her baton 22 feet high during the halftime finale, giving her 2 seconds to twirl twice and catch it.

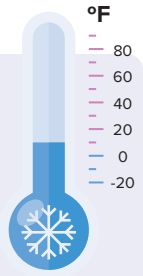
- Independent quantity:
  Time (seconds)
- Dependent quantity:
  Height of baton (feet)

  Origin: (0 seconds, height of 0 feet)



5 Cold Weather Graph A

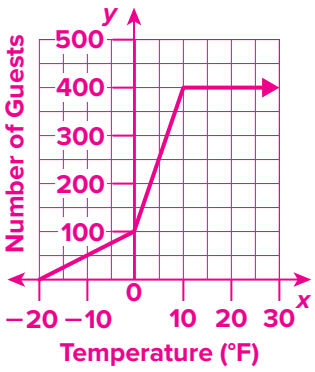
The number of guests at a ski resort depends on the day's high temperature. No one visits at −20°F or below. As temperatures rise, guests increase. At 0°F and above, attendance surges, reaching the 400-guest capacity at 10°F or higher.



- Independent quantity:

- Dependent quantity:
  Number of guests

  Origin: (0 degrees Fahrenheit, 0 number of guests)



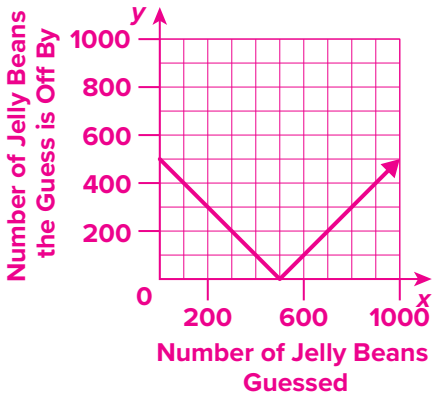
6 Jelly Bean Challenge Graph C

Mr. Vasquez judges the Jelly Bean Challenge at the summer fair, recording all possible guesses and how far each is from the actual count.

- Independent quantity:
  Number of jelly beans guessed

- Dependent quantity:
  Number of jelly beans the guess is off by

  Origin: (0 jelly beans guessed, 0 jelly beans the guess is off by)



7 Compare the graphs for each pair of situations given. Describe any similarities and differences you notice.

Think About . . .
Look closely when analyzing the graphs. What do you see?

a. *Smart Phone, But Is It a Smart Deal?* and *Cold Weather*

Sample answers:
Both graphs increase from left to right.

The graph of the *Smart Phone, But Is It a Smart Deal?* situation is a smooth curve, but the graph of the *Cold Weather* situation is composed of two increasing and one constant line segments.

b *Something's Fishy* and *Daredevil*

Sample answers:

Both graphs decrease from left to right.

The graph of the *Something's Fishy* situation is a straight line, but the graph of the *Daredevil* situation is a smooth curve.

c *Baton Twirling* and *Jelly Bean Challenge*

Sample answers:

The graphs have either a minimum or a maximum value. Both graphs increase and decrease.

The graph of the *Baton Twirling* situation is a smooth curve, but the graph of the *Jelly Bean Challenge* situation is made up of two straight lines.

Reflect A Writer and a Mathematician

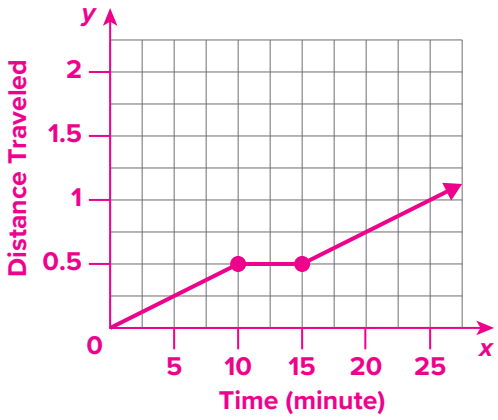
1 Write a situation and sketch a graph to describe a possible trip to school.

Situation

Sample answer:

I walk half a mile to school in 10 minutes. Then, I stop to talk to a friend and tie my shoes for 5 minutes. I walk the remaining half-mile to school in 10 minutes.

Graph



2 Describe the meaning of the points, or smooth curve, represented by your graph.

Sample answer:

Each point on the graph represents possible times and the corresponding distances.

3 Compare your situation and sketch with your classmates' situations and sketches. What similarities do you notice? What differences do you notice?

Answers will vary.

Quick Check: A Picture is Worth a Thousand Words

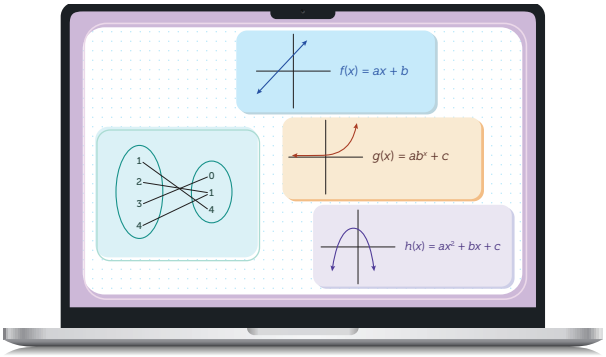
Practice builds new connections in your brain. You can use these practice activities to develop your mathematical knowledge.

Interactive Assignment

A Picture is Worth a Thousand Words with LiveHint

Interactive Skills Practice

Identifying Independent and Dependent Quantities



Independent Practice

Determine the independent and dependent quantities in each situation. Be sure to include the appropriate units of measure for each quantity.

1. Baila reads a 300-page book at a rate of 20 pages per hour.
2. A car wash business charges $15 per car for a basic wash.
3. Ashley drinks water at a steady rate of 0.5 liters per 15 minutes while hiking.
4. A library allows users to borrow books for 2 weeks per loan period.
5. A group of friends purchases tickets to a concert. Tickets cost $75 each.
6. A hose fills a swimming pool at a rate of 8 gallons per minute.
7. The temperature drops 2 degrees Fahrenheit per hour overnight.
8. A construction company rents a bulldozer for $150 per day.