LESSON 15

Understand Functions

Dear Family,

This week your student is learning about **functions**. A function is a rule that defines a relationship between two quantities. When these rules are applied, one quantity, called the **input**, results in another quantity, called the **output**. For a rule to be a function, each input must have *exactly* one output.

Students will be learning to determine if relationships between two quantities are functions, such as in the problem below.

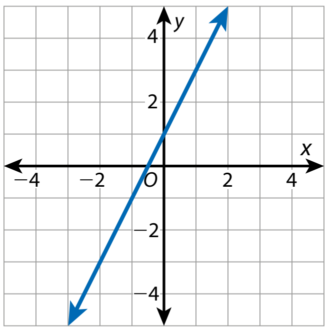
Does the equation $y = 2x + 1$ represent a function?

ONE WAY to explore a function is to use a table.

Input (x)	-3	-2	-1	0	1	2	3
Output (y)	-5	-3	-1	1	3	5	7

The table shows that this rule produces one output for each input.

ANOTHER WAY is to use a graph.



The graph shows that there is only one output, or y-value, for each input, or x-value. The graph also shows a straight line. The equation represents a **linear function**.

Using either method, the equation $y = 2x + 1$ represents a function.

Use the next page to start a conversation about functions.

Activity Thinking About Functions

➤ **Do this activity together to investigate functions in the real world.**

You may be familiar with many real-world functions! For example, suppose cherries cost $3 a pound. A rule for finding the cost of a bag of cherries is *multiply the weight in pounds by $3*. This rule is a function because each weight has only one cost.

? Can you think of other examples of functions in the real world?

LESSON 16

Use Functions to Model Linear Relationships

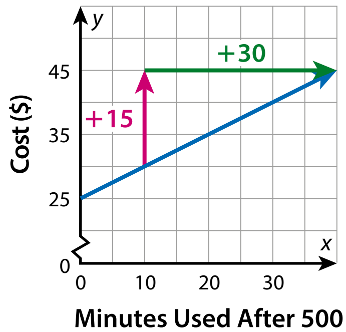
Dear Family,

Previously, your student learned how to recognize linear functions. This week your student is learning how to use linear functions to model relationships. A linear function has a constant rate of change and can be modeled by an equation in the form of $y = mx + b$. Students will be learning to interpret linear functions that model real-world situations, such as in the problem below.

> A phone company charges \$25 per month for 500 minutes of talk time. If users go over 500 minutes, there is an additional charge per each minute over 500. The linear function $y = \frac{1}{2}x + 25$ gives the cost of the monthly phone plan, y, for x minutes over the first 500 minutes. What is the charge per additional minute over 500?

➤ **ONE WAY** to interpret the linear function is to graph the equation.

From the graph you can see that the slope of the line, or the rate of change of the function, is $\frac{15}{30} = \frac{1}{2}$.



➤ **ANOTHER WAY** is to look at the different parts of the function equation.

$$y = \underbrace{\frac{1}{2}}_{\text{Rate of change}}x + \underbrace{25}_{\text{Initial value}}$$

Using either method, the company charges \$0.50 per additional minute over 500.

Use the next page to start a conversation about linear functions.

Activity Thinking About Using Functions to Model Linear Relationships

➤ **Do this activity together to investigate linear functions in the real world.**

Functions can be used to model linear relationships between two quantities. You can find unknown values by writing an equation to represent a linear relationship. For example, suppose you ride your bike at a rate of 0.2 mile per minute. You can use the equation $y = 0.2x$, where y is distance in miles and x is time in minutes, to figure out that it would take you 50 minutes to travel 10 miles!

? When else might you want to use a function to think about linear relationships?

LESSON 17

Dear Family,

This week your student is learning about comparing different representations of functions. Students will compare functions that are represented in a variety of ways, including graphs, tables, equations, and words. They will learn to use these different representations to answer questions about functions, such as in the problem below.

A museum sells adult and student day passes for its new dinosaur exhibit. The equation for the cost, C, of n student passes is $C = 12n$. The table shows the costs of adult passes. What is the difference in cost of the two types of passes?

Number of Passes	1	2	3	4
Cost ($)	20	40	60	80

ONE WAY to find the difference is to compare costs for one pass.

Student: Substitute 1 for n in the equation: $C = 12(1) = 12$.

Adult: You can see from the table that 1 pass costs \$20.

ANOTHER WAY is to compare rates of change.

Student: Using the equation, the rate of change is 12.

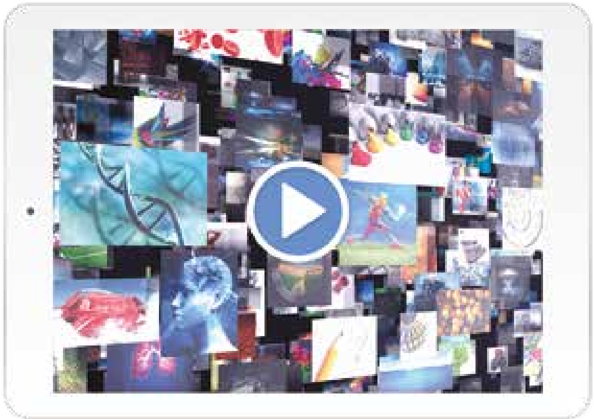
Adult: Using the table, the rate of change is $\frac{40 - 20}{2 - 1} = 20$.

Using either method, the difference in the cost of the two types of passes is \$20 − \$12 = \$8.

Use the next page to start a conversation about different representations of functions.

Compare Different Representations of Functions

Activity Thinking About Different Representations of Functions



➤ **Do this activity together to investigate different representations of functions.**

Different representations of functions can be compared to find useful information. Below are representations of the costs of three different movie streaming services as functions of the number of movies watched.

? What conclusions can you draw about each function based on its representation?

STREAMING SERVICE 1:

$C = m + 15$

C is the cost in dollars and m is the number of movies watched.

STREAMING SERVICE 2:

This service does not charge a base fee. It costs $4 per movie watched.

STREAMING SERVICE 3:

Movies Watched	0	1	2	3	4
Cost ($)	10	12	14	16	18

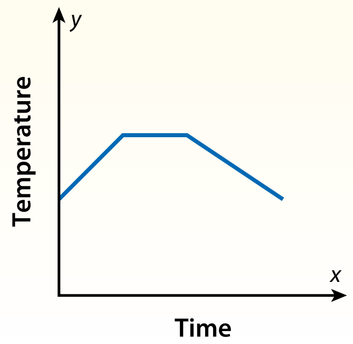
LESSON 18

Dear Family,

This week your student is learning how to analyze and interpret graphs of functions. Students will learn to write descriptions of functions based on their graphs. These **qualitative descriptions** of functions use the shapes and directions of the graphs, and often do not rely on exact numbers or quantities.

Many of the graphs in this lesson represent a quantity that changes over time. By analyzing the graph from left to right, students learn the *story* of that change. Students will solve problems like the one below.

The graph shows the temperature for a day in a city. Write a qualitative description of the temperature throughout the day.



ONE WAY to describe the function is to break it into sections.

The graph is made up of three line segments. The first segment slants up from left to right. This shows that the temperature increased at a constant rate early in the day. The second segment is horizontal. So, in the middle of the day, the temperature did not change. The third segment slants downward, so the temperature decreased at a constant rate at the end of the day.

ANOTHER WAY is to write a description as you *read* the graph from left to right.

The graph shows the temperature increasing steadily for the first part of the day. Then the temperature stays the same for a little while, and then it drops at a consistent rate later in the day.

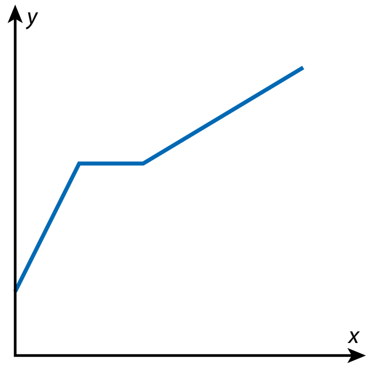
Using either method, the descriptions explain temperature rising, staying the same, and then falling over the course of the day.

Use the next page to start a conversation about functional relationships.

Activity Thinking About Analyzing Functional Relationships Qualitatively

➤ **Do this activity together to investigate functional relationships in the real world.**

Qualitative descriptions of functional relationships tell stories about how two quantities change in relation to each other. This graph models how one quantity increases rapidly at a constant rate, then stays the same, and then increases more slowly, with respect to the other quantity. One example of a situation this could represent is distance traveled as a function of time, where a person sprints at a constant rate, stops to rest, and then jogs at a slower pace.



Can you think of another situation, or story, that the graph could represent?