Edgenuity

# Warm-Up | Introduction to Linear Functions

**Lesson Question**

What type of relationship has a graph that is a line?

## Lesson Goals

**Determine** the rate of change of a continuous or discrete function using a table or a graph.

**Analyze** rate of change to determine if a function is linear.

**Calculate** the initial value of a linear function.

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## Words to Know

*Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.*

| | |
|---|---|
| _C_ dependent variable | A. the output of a function when the input is zero |
| _D_ independent variable | B. a function that can be written in the form $y = mx + b$, where $m$ and $b$ are real numbers; consists of a set of ordered pairs all lying on the same line |
| _A_ initial value | C. the variable in a function that represents the output values, or the second coordinate in the ordered pairs |
| _B_ linear function | D. the variable in a function that represents the input values, or the first coordinate in the ordered pairs |
| _E_ rate of change | E. in a function, the ratio of the change in the dependent value with respect to the change in the independent value |

## Independent and Dependent Variables

Michaela earns $8 per hour at an after-school job.

For a function that gives the amount earned for working a given amount of hours:

- The independent variable (input) is the number of hours worked.
- The dependent variable (output) is the amount earned.

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## Analyzing a Scenario: Completing a Table

Determine the relationship between the independent variable and the dependent variable.

Michaela earns $8 per hour at an after-school job.

| Hours worked, $x$ | Amount Earned, $y$ |
|---|---|
| 0 | $0 |
| 1 | $ 8 |
| 2 | $ 16 |
| 3 | $24 |
| 4 | $ 32 |

- What is the domain of the given scenario?

  non-negative numbers

- What is the range of the given scenario?

  non-negative numbers

## Rate of Change from a Table

Michaela earns $8 per hour at an after-school job.

| Hours worked, $x$ | Amount Earned, $y$ | |
|---|---|---|
| 0 | 0 | |
| 1 | 8 | +8 |
| 2 | 16 | +8 |
| 3 | 24 | +8 |
| 4 | 32 | +8 |
| | | +1 |
| | | +1 |
| | | +1 |
| | | +1 |

Rate of change is the [ratio] of the change in the dependent value with respect to the change in the independent value.

$$\text{Rate of change} = \frac{\text{[dependent] value}}{\text{independent value}} = \frac{\text{[+8]}}{\text{[+1]}} = \text{[8]}$$

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## Graphing a Linear Function

Michaela earns $8 per hour at an after-school job. The graph shows the relationship between the number of [hours] Michaela works and the amount she [earns].


A linear function describes the relationship between two quantities having a [constant] additive rate of change. The graph of a linear function is a [straight] line.

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## Analyzing a Scenario

Manuel is selling baseball caps for a fundraiser. The table shows the relationship between the number of caps sold and the amount of money Manuel has collected.

What is the rate of change for the given function?

| independent variable | dependent variable |
|---|---|
| **Number of Caps Sold** | **Amount of Money Collected ($)** |
| 2 | 10 |
| 4 | 15 |
| 6 | 20 |

$$\text{Rate of change} = \frac{\text{dependent}}{\text{independent}} = \frac{+5}{+2}$$

2.5 or $ 2.50 for 1 cap

There is a constant additive rate of change, so the points will make a straight line, or a linear function.

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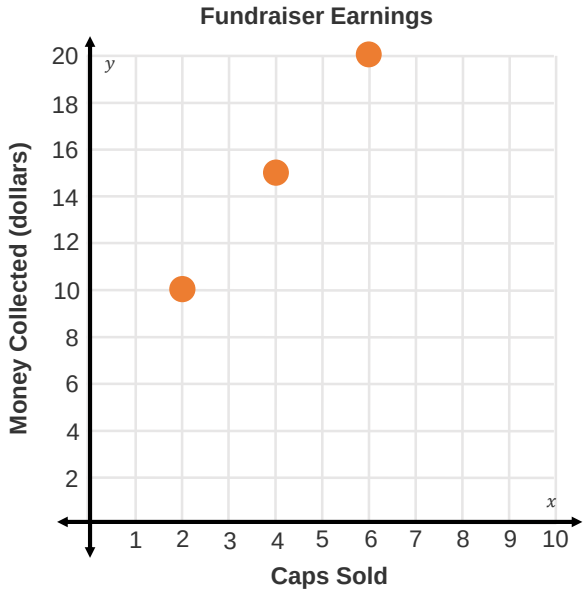
## Discrete Linear Functions

Initial value is the [starting] value of a function when the independent variable is zero.

Manuel is selling baseball caps for a fundraiser. The graph shows the relationship between the number of caps sold and the amount of money Manuel has collected. How much money did Manuel start this fundraiser with?




The graph is discrete, meaning that the graph is made up of individual points and not a line.

**Domain:** [whole] numbers

Manuel started this fundraiser with $ [5] .

**Range:** numbers greater than or equal to [5]

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## Linear vs. Nonlinear Functions

Linear **function** → Has a constant additive rate of change

Nonlinear **function** → Does not have a constant additive rate of change

## Recognizing Rate of Change from Table

This table displays the approximate height and distance traveled by a soccer ball that was kicked across a field.

non-linear function: not a constant rate of change

linear function: constant rate of change

| Time (seconds) | Height (yards) | Distance (yards) |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 5.3 | 17 |
| 2 | 8 | 34 |
| 3 | 9.8 | 51 |

+1, +1, +1 (time)

+5.3, +2.7, +1.8 (height)

+17, +17, +17 (distance)

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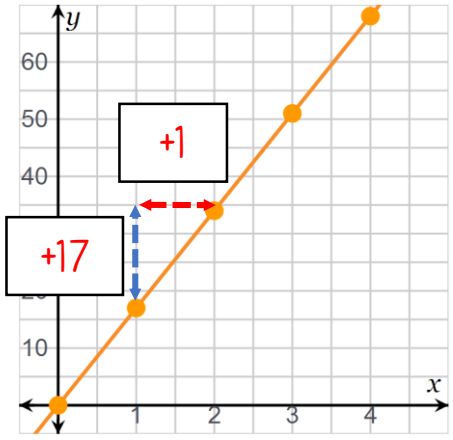
## Linear Function

### IDENTIFYING A LINEAR FUNCTION

This shows the height and distance traveled by a soccer ball.

| Time (seconds) | Height (yards) | Distance (yards) |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 5.3 | 17 |
| 2 | 8 | 34 |
| 3 | 9.8 | 51 |
| 4 | 7.7 | 68 |

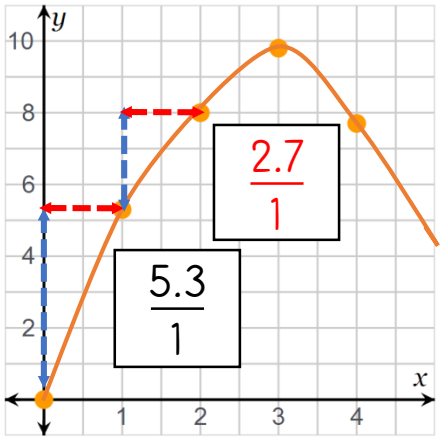



The slope is the same between different points. Since the rate of change is constant, that makes this a [linear] function. We can see it from the graph, which makes a [straight line].

### IDENTIFYING A NONLINEAR FUNCTION

This shows the height and distance traveled by a soccer ball.

| Time (seconds) | Height (yards) | Distance (yards) |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 5.3 | 17 |
| 2 | 8 | 34 |
| 3 | 9.8 | 51 |
| 4 | 7.7 | 68 |



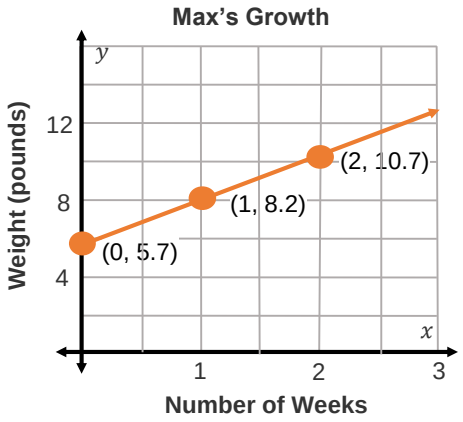

This is a [nonlinear] function.

## Comparing Linear Relationships

Compare the different linear representations of Rex's and Max's growth as puppies. Which puppy grew at a faster rate? Which puppy weighed more when born?

**Rex's Growth**

| Number of Weeks | Weight (pounds) |
|---|---|
| 2 | 11 |
| 3 | 13.5 |
| 4 | 16 |




Rex's rate of change: $\frac{2.5}{1}$

Max's rate of change: $\frac{2.5}{1}$

Both puppies have a rate of change of 2.5 pounds per week, so neither grew at a faster rate.

Rex weighed 6 lb at birth.

Max weighed 5.7 lb at birth.

Rex weighed 0.3 lb more at birth.

# Summary | Introduction to Linear Functions

**Lesson Question**

What type of relationship has a graph that is a line?

**Answer**

If a function has a constant additive rate of change, then the function is linear.

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## Key Concepts

- The rate of change is the ratio of the change in the dependent value with respect to the change in the independent value.
- A linear function describes the relationship between two quantities having a constant additive rate of change.
- The graph of a linear function is a straight line.

| $x$ | $y$ |
|---|---|
| 0 | 5.75 |
| 1 | 7.25 |
| 2 | 8.75 |
| 3 | 10.25 |

Initial value: 5.75

Rate of change: $\frac{1.5}{1}$

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*Use this space to write any questions or thoughts about this lesson.*