

# Ratios Summary

## KEY TERMS

- additive reasoning
- multiplicative reasoning
- ratio
- percent
- equivalent ratios
- tape diagram
- rate
- proportion
- scaling up
- scaling down
- double number line
- linear relationship

LESSON  
**1**

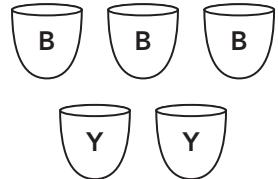
## It's All Relative

**Additive reasoning** focuses on the use of addition and subtraction for comparisons.

**Multiplicative reasoning** focuses on the use of multiplication and division.

A **ratio** is a comparison of two quantities that uses division.

For example, an art teacher knows it takes 3 parts blue paint to every 2 parts yellow paint to create a certain shade of bluish green. This is represented by the model shown.



A part-to-whole ratio compares a part of a whole to the total number of parts.

3 to 5 is a part-to-whole ratio comparing blue parts to total parts.

### With a Colon

3 blue parts : 5 total parts

### In Fractional Form

$$\frac{3 \text{ blue parts}}{5 \text{ total parts}}$$

A part-to-part ratio compares individual quantities.

2 to 3 is a part-to-part ratio comparing yellow parts to blue parts.

### With a Colon

2 yellow parts : 3 blue parts

### In Fractional Form

$$\frac{2 \text{ yellow parts}}{3 \text{ blue parts}}$$

Fractional form simply means writing the relationship in the form  $\frac{a}{b}$ . Just because a ratio looks like a fraction does not mean it represents a part-to-whole comparison. Only a part-to-whole ratio is a fraction.

A **percent** is a part-to-whole ratio where the whole is equal to 100. The percent symbol “%” means “per 100,” or “out of 100.”

35% means 35 out of 100.

35% as a fraction is  $\frac{35}{100}$ .

35% as a decimal is 0.35.

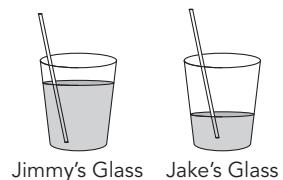
35% as a ratio is 35 to 100, or 35 : 100.

LESSON  
**2**

## Going Strong

One ratio can be less than, greater than, or equal to another ratio.

For example, the shaded portion in each glass represents an amount of lemonade. Suppose Jimmy and Jake have glasses of lemonade that taste the same. If one teaspoon of lemonade mix is added to each glass, Jake’s glass will now contain lemonade with a stronger lemon flavor. The ratio of lemon mix to lemonade is greater in Jake’s glass because he had less lemonade in the glass to begin with.



The cups represent different ratios of lemon-lime soda to pineapple juice in two different punches.

Punch A



Punch B



lemon-lime soda      pineapple juice

The concentration of lemon-lime soda in Punch A is  $\frac{2}{6}$ . The concentration of lemon-lime soda in Punch B is  $\frac{2}{5}$ . Punch B has a greater concentration of lemon-lime soda.

LESSON  
**3**

## Oh, Yes, I Am the Muffin Man

**Equivalent ratios** are ratios that represent the same part-to-part or part-to-whole relationship. You can use a tape diagram to help determine equivalent ratios. A **tape diagram** illustrates number relationships by using rectangles to represent ratio parts.

For example, the ratio of muffins in a variety pack is 3 blueberry muffins : 2 pumpkin muffins : 1 bran muffin and is represented by the tape diagram shown.

To determine how many of each type of muffin are in an 18-pack of muffins, you need to maintain the same ratio. Since there are 6 muffins represented in the tape diagram, divide 18 by 6.

Since  $18 \div 6 = 3$ , each rectangle will represent 3 muffins. The ratio of muffins in an 18-pack will be 9 blueberry muffins : 6 pumpkin muffins : 3 bran muffins.

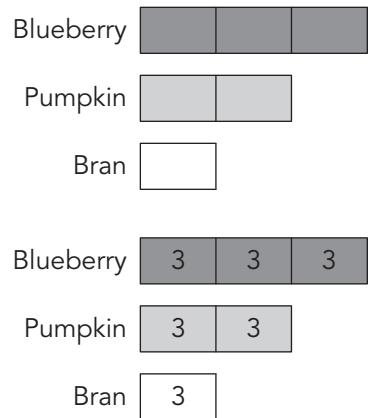
A **rate** is a ratio that compares two quantities that are measured in different units.

For example, Kaye can answer 4 problems correctly in five minutes. This rate can be written as  $\frac{4 \text{ problems correct}}{5 \text{ minutes}}$ .

When two ratios or rates are equivalent to each other, you can write them as a proportion. A **proportion** is an equation that states that two ratios are equal. In a proportion, the quantities composing each part of the ratio have the same multiplicative relationship between them.

You can predict how many problems Kaye could answer correctly in 20 minutes.

Kaye can probably answer 16 problems correctly in 20 minutes.



$$\frac{\text{problems correct}}{\text{minutes}} = \frac{4}{5} = \frac{16}{20}$$

Diagram illustrating the proportion  $\frac{\text{problems correct}}{\text{minutes}} = \frac{4}{5} = \frac{16}{20}$ . Arrows labeled  $\times 4$  show the scaling from the first ratio to the second. The second ratio is shown with a box around the 16.

When you change one ratio to an equivalent ratio with larger numbers, you are scaling up.

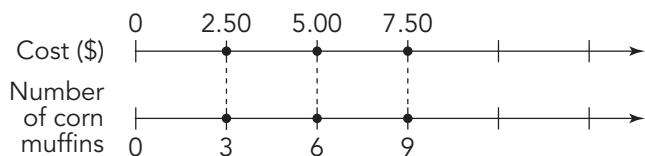
**Scaling up** means you multiply both parts of the ratio by the same factor greater than 1.

When you change a ratio to an equivalent ratio with smaller numbers, you are scaling down.

**Scaling down** means you divide both parts of the ratio by the same factor greater than one, or multiply both parts of the ratio by the same factor less than one.

A **double number line** is a model that is made up of two number lines used together to represent the ratio between two quantities. The intervals on each number line maintain the same ratio.

For example, the ratio \$2.50 : 3 corn muffins is shown on the double number line. You can see other equivalent ratios of cost : *number of corn muffins* by continuing to label each interval.



LESSON  
**4**

## A Trip to the Moon

You can use ratio tables to show how two quantities are related. Ratio tables are another way to organize information.

You can use a table to represent, organize, and determine equivalent ratios. You can use addition and multiplication to create equivalent ratios.

For example, the table shown represents three equivalent ratios of weight on Earth (lb) : weight on the Moon (lb). The ratio of 60 lb on Earth : 10 lb on the Moon is given. One equivalent ratio was determined by dividing the original ratio by 2. Another was determined by adding two equivalent ratios.

Weight on Earth (lb)	60	30	90
Weight on the Moon (lb)	10	5	15

Diagram illustrating the creation of equivalent ratios:

- An arrow labeled "÷2" points from the first column (60) to the second column (30).
- An arrow labeled "add" points from the first column (60) to the third column (90).
- An arrow labeled "÷2" points from the second column (10) to the third column (5).
- An arrow labeled "add" points from the second column (10) to the fourth column (15).

LESSON  
**5**

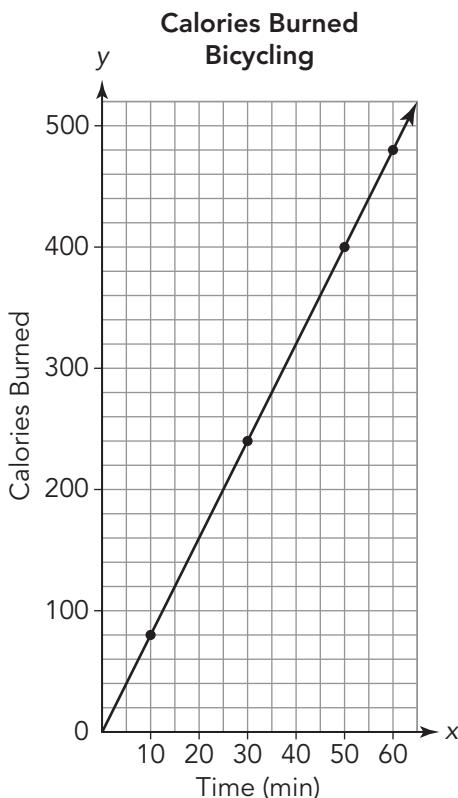
## They're Growing!

Equivalent ratios can also be represented on the coordinate plane. The ratio  $\frac{y}{x}$  is plotted as the ordered pair  $(x, y)$ . When you connect the points that represent equivalent ratios, you form a straight line that passes through the origin. In contrast, non-equivalent ratios are those represented by points that do not create by a straight line through the origin. When a set of points graphed on a coordinate plane forms a straight line, a **linear relationship** exists.

For example, the table charts the number of calories Valerie burns for different amounts of time.

Calories Burned	240	80	480	400
Time (mins)	30	10	60	50

The values are plotted on the graph.



The graph shows that Valerie would burn 200 calories after bicycling for 25 minutes and that it would take between 35 and 40 minutes of bicycling for her to burn 300 calories.

LESSON  
**6**

## One Is Not Enough

You can use a number of different models, like graphs, tables, double number lines, and tape diagrams to analyze ratios and ratio relationships and to solve problems.

For example, by comparing the graphed lines that represent each ratio of *number of tickets: cost*, you can tell that the cost to ticket rate is the greatest for adults because it has the steepest line. Likewise, the cost to ticket rate is the lowest for the pre-schoolers because it has the least steep line.

