



# How to support your student as they learn about

## Relating Quantities

Mathematics is a connected set of ideas, and your student knows a lot. Encourage them to use the mathematics they already know when seeing new concepts in this module.

### Module Introduction

In this module your student will learn more about ratio and proportional relationships. There are 3 topics in this module: *Ratios*, *Percents*, and *Unit Rates and Conversions*. Your student will use what they already know about equivalent fractions in this module.

### Academic Glossary

Each module will highlight an important term. Knowing and using these terms will help your student think, reason, and communicate their math ideas.

Term	Explain Your Reasoning
Definition	<ul style="list-style-type: none"><li>To give details or describe how to determine an answer or solution.</li><li>Explaining your reasoning helps prove your conclusions.</li></ul>
Questions to Ask Your Student	<ul style="list-style-type: none"><li>How can you organize your thoughts?</li><li>Does your reasoning make sense?</li><li>How can you prove your answer?</li></ul>
Related Phrases	<ul style="list-style-type: none"><li>Show your work</li><li>Explain your calculation</li><li>Justify</li><li>Why or why not?</li></ul>

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Mega Bag (32 oz)	\$10.24
Giant Bag (24 oz)	\$6.00
Medium Bag (16 oz)	\$4.48
Kid's Bag (8 oz)	\$2.40

Compare the prices of various sizes of popcorn sold at the local movie theater.

What is the unit price per ounce for each bag of popcorn?

What size popcorn is the best buy?

**Explain your reasoning.**



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## Math Process Standards

Each module will focus on a process (or a pair of processes) that will help your student become a mathematical thinker. The “I can” statements listed below help your student to develop their mathematical learning and understanding.

*Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.*

I can:

- work carefully and check my work.
- distinguish correct reasoning from reasoning that is flawed.
- use appropriate mathematical vocabulary when I talk with my classmates, my teacher, and others.
- specify the appropriate units of measure when I explain my reasoning.
- calculate accurately and communicate precisely to others.

Look for examples of these processes in the Topic Summaries.

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## The Carnegie Learning Way

### Lesson Structure

Each lesson is laid out in the same way to develop deep understanding. Read through the parts of the lesson to learn more about your student’s learning in their math classroom.

### Learning Goals & Connection

Each lesson begins with learning goals which are listed to help students understand the learning objectives. Also included is a statement connecting what students have learned with a question to ponder. At the end of each lesson, the question is asked again to see how much your student understands.

### Getting Started

In the Getting Started, your student uses what they already know about the world, what they’ve already learned, and their intuition to get them thinking mathematically and prepare them for what’s to come in the lesson.

### Activities

The activities in the lessons build a deep understanding of the math. These activities provide your student with the opportunity to communicate and work with others in their math classroom.



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When your student is working through these activities, we encourage:

- It's not just about answer-getting. Doing the math and talking about it is important.
- Making mistakes is an important part of learning, so take risks.
- There is often more than one way to solve a problem.

### Talk the Talk

Talk the Talk gives your student an opportunity to reflect on the main ideas of the lesson.


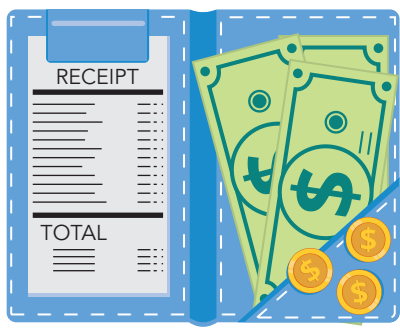
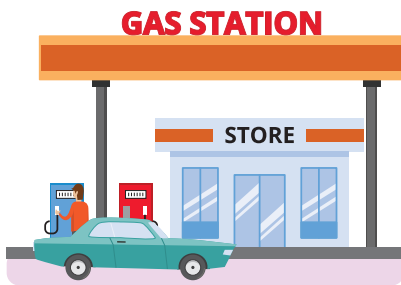


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## Module Overview





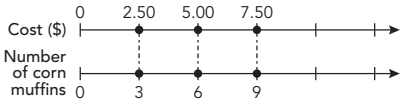

TOPIC 1	TOPIC 2	TOPIC 3
Ratios	Percents	Unit Rates and Conversions
21 Days	10 Days	10 Days
Your student will use their multiplicative reasoning to establish ratio reasoning.	Your student will analyze percents as a special type of ratio, a rate per 100.	Your student will develop an understanding of unit rates, a special type of ratio, and conversion rates, a special type of unit rate.
<p>Did you know that?</p>  <p>When the creamer hits the coffee, the math is magical. With each cup, you create a <b>ratio</b> of creamer to coffee.</p> <p>A ratio is a comparison of two quantities that uses division. You can compare the ratio of creamer to coffee without measuring or counting quantities. When you reason like this, it is called <i>qualitative reasoning</i>.</p> <p>Which cup contains the coffee with the strongest coffee flavor?</p>	<p>Did you know that?</p>  <p>Deciding how much tip to leave a server at a restaurant is one way that percents are used in the real world.</p> <p>To leave a 15% tip, you can easily calculate 10% of any number and then calculate half of that, which is equal to 5%. You can add those two percent values together to get a sum of 15%.</p> <p>What is 15% of \$60?</p> <p>[\$9]</p>	<p>Did you know that?</p>  <p>When you decide to bypass one gas station for the one down the road because their gas is a few cents cheaper, you are comparing <b>unit rates</b>.</p> <p>A unit rate is a comparison of two measurements in which the denominator has a value of one unit.</p> <p>Which option is the better buy?</p> <p>Gas station #1: \$3.49 per gallon Gas station #2: \$3.54 per gallon</p> <p>[Gas station #1]</p>



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## Topic 1: Ratios

Key Terms		
<ul style="list-style-type: none"> <li>• additive reasoning</li> <li>• multiplicative reasoning</li> <li>• ratio</li> <li>• percent</li> <li>• equivalent ratios</li> <li>• strip diagram</li> <li>• rate</li> <li>• proportion</li> <li>• scaling up</li> <li>• scale factor</li> <li>• scaling down</li> <li>• double number line</li> <li>• linear relationship</li> </ul>		
<p>A <b>ratio</b> is a comparison of two quantities that uses division.</p> <p></p> <p>The ratio of stars to circles is <math>\frac{3}{2}</math>, or 3 : 2, or 3 to 2.</p> <p>The ratio of circles to stars is <math>\frac{2}{3}</math>, or 2 : 3, or 2 to 3.</p>	<p>A <b>strip diagram</b> illustrates number relationships by using rectangles to represent ratio parts.</p> <p>A bakery sells packs of muffins in the ratio of 3 blueberry muffins : 2 pumpkin muffins : 1 bran muffin. The strip diagram represents the ratio of each type of muffin.</p> <p>Blueberry </p> <p>Pumpkin </p> <p>Bran </p>	<p>A <b>double number line</b> is a model that is made up of two number lines used together to represent the ratio between two quantities.</p> <p></p>
 Follow the link to access the Mathematics Glossary: <a href="https://www.carnegielearning.com/texas-help/students-caregivers/">https://www.carnegielearning.com/texas-help/students-caregivers/</a>		



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## Ratios

Students begin this topic by learning about ratios as multiplicative comparisons. They distinguish between additive and multiplicative relationships between two quantities.

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

- “More than” and “less than” are examples of additive comparisons

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

- “Twice as many” and “one half as many” are examples of multiplicative comparisons

### MATH PROCESS STANDARDS

**How do the activities in *Ratios* promote student expertise in the math process standards?**

**NOTE:** This is an example of the math process standard:

*Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.*

- I can distinguish correct reasoning from reasoning that is not correct.
- I can use mathematical vocabulary when I talk with my classmates, my teacher, and others.

Have your student refer to page 2 for more “I can” statements.

Robena and Eryn each predicted the final score of a basketball game between the Crusaders and the Blue Jays.

#### Robena

	Halftime Score	Final Score
Crusaders	30	60
Blue Jays	20	40

I think the final score will be double the score at halftime.

#### Eryn

	Halftime Score	Final Score
Crusaders	30	50
Blue Jays	20	40

I think the Crusaders will play hard enough to stay 10 points ahead of the Blue Jays.

Describe the reasoning that Robena and Eryn used to make each statement.

Which student used additive reasoning and which student used multiplicative reasoning?



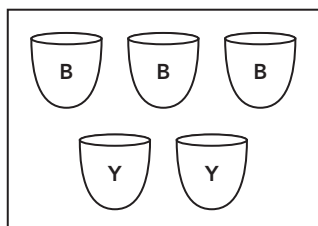
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## Comparing Quantities

Students learn about quantitative relationships represented by ratios and the different ways to represent ratios. There are different ways to think about relationships and make comparisons. One way is to draw a model.



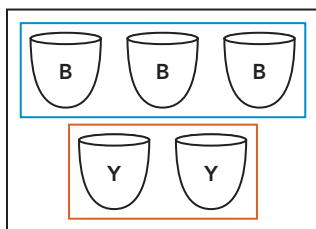
The school colors at Riverview Middle School are a shade of bluish-green and white. The art teacher, Mr. Raith, knows to get the correct color of bluish-green, it takes 3 parts blue paint to every 2 parts yellow paint.

From the model, you can make comparisons of the different quantities.

- blue parts to yellow parts
- yellow parts to blue parts
- blue parts to total parts
- yellow parts to total parts

Each comparison is called a *ratio*.

## Part-to-Part versus Part-to-Whole Ratios

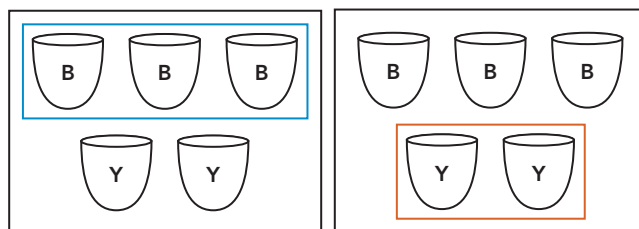


### Part-to-Part Ratio

blue parts to yellow parts  
yellow parts to blue parts

A part-to-part ratio compares individual quantities.

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



### Part-to-Whole Ratio

blue parts to total parts  
yellow parts to total parts

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.



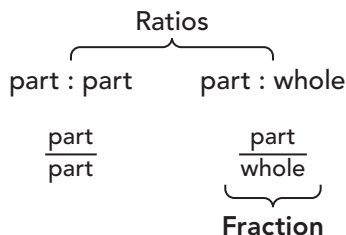
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## Special Types of Ratios

When a ratio is written using the total number of parts, you are writing a fraction. A fraction can be used as a ratio that shows a part-to-whole relationship.



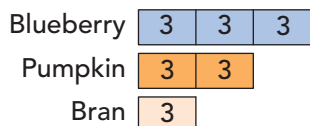
Fractional form simply means writing the relationship in the form  $\frac{a}{b}$ . Just because a ratio looks like a fraction does not mean it represents a part-to-whole comparison. Only a part-to-whole ratio is a fraction.

A **percent** is a part-to-whole ratio where the whole is equal to 100. Percent is another name for hundredths. The percent symbol “%” means “out of 100.”

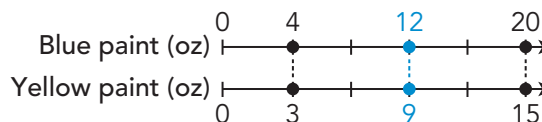
## Equivalent Ratios

Students will use different models of equivalent ratios. They reason why these models work.

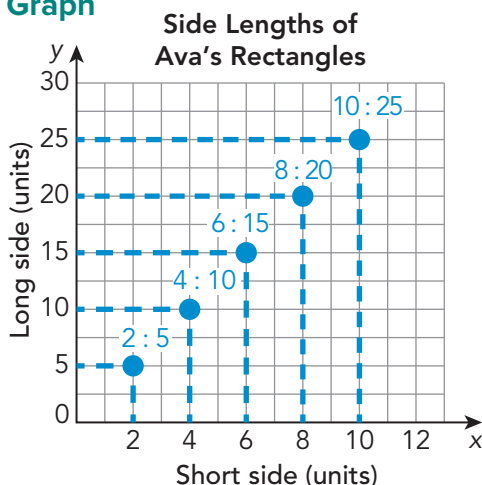
### Strip Diagram



### Double Number Line



### Graph



### Ratio Table

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



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## Proportions

When two ratios or **rates** are equal to each other, they can be written 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.

To change a ratio to an equivalent ratio you can scale up or scale down.

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

$$\frac{2 \text{ blueberry muffins}}{5 \text{ total muffins}} = \frac{20 \text{ blueberry muffins}}{? \text{ total muffins}}$$

Scale up the ratio to determine the unknown number.

What factor did you use to scale up the ratio?

[50 total muffins; You can use a factor of 10.]

**Scaling down** means you divide both parts of the ratio by the same factor greater than 1, or you multiply both parts of the ratio by the same factor less than 1.

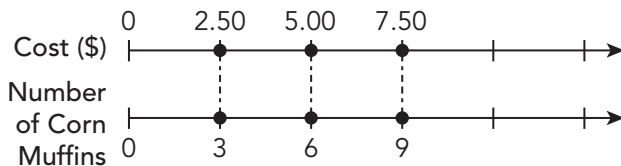
$$\frac{20 \text{ hours of work}}{\$240} = \frac{1 \text{ hour of work}}{?}$$

Scale down the ratio to determine the unknown number. What factor did you use to scale down the ratio?

[12 hours of work; You can use a factor of 20]

## Using Double Number Lines to Determine Equivalent Ratios


A double number line shows two connected number lines. The number lines are connected by equivalent ratios. For example, this double number line shows that 3 corn muffins for \$2.50 is equivalent to 6 corn muffins for \$5.00.



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## Topic 2: Percents

Key Terms	
<ul style="list-style-type: none"><li>• benchmark percent</li></ul>	
A <b>benchmark percent</b> is a percent that is commonly used, such as 1%, 5%, 10%, 25%, 50%, and 100%.	
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### Percents, Fractions, and Decimals

In this topic, students focus on a special ratio relationship: percent. Students learn that a percent can be defined multiple ways: as a ratio, as a decimal to the hundredths place, and as a part-to-whole relationship in which the whole is 100.

Your student will learn that a **percent** is a part-to-whole ratio where the whole is equal to 100.

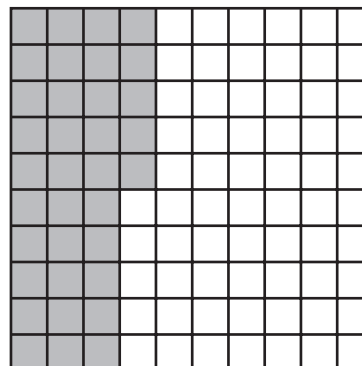
35% means 35 out of 100.

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.

You can shade 35 of the 100 squares on the hundredths grid to represent 35%.



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When the denominator is a factor of 100, scale up the fraction to write it as a percent.

$$\begin{array}{c} \times 20 \\ \curvearrowright \\ \frac{4}{5} = \frac{80}{100} \\ \curvearrowleft \\ \times 20 \\ \frac{80}{100} = 80\% \end{array}$$

When the denominator is not a factor of 100, you can divide the numerator by the denominator to write the fraction as a decimal, which you can then write as a percent.

$$\begin{array}{r} 0.625 \\ 8 \overline{) 5.000} \\ \underline{- 48} \phantom{00} \\ 20 \phantom{00} \\ \underline{- 16} \phantom{00} \\ 40 \phantom{00} \\ \underline{- 40} \\ 0 \end{array} \quad \frac{5}{8} = 5 \div 8$$

$0.625 = 62.5\%$

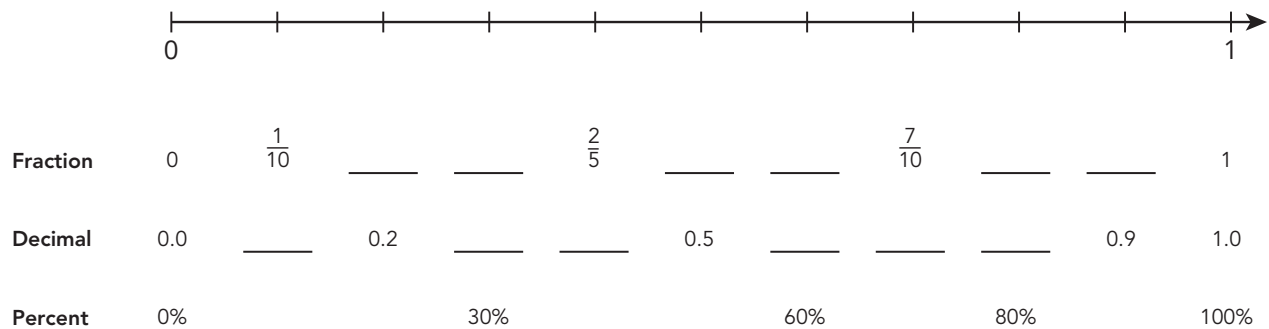
Also in this topic, your student will complete number lines of common fractions, decimals, and percent equivalences.

Label each mark on the number line with a fraction, decimal, and percent. Make sure your fractions are in lowest terms.

Remember to:

- work carefully and check your work.
- calculate accurately and communicate precisely to others.

Example:



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### Benchmark Percents

A **benchmark percent** is a percent that is commonly used, such as 1%, 5%, 10%, 25%, 50%, and 100%. With fractions and decimals, benchmarks can be used to make estimations. Your student can use benchmarks to calculate any whole percent of a number.

You can determine any whole percent of a number by using 10%, 5%, and 1%.

For example, what is 26% of 300?

$$26\% = 10\% + 10\% + 5\% + 1\%$$

$$10\% \text{ of } 300 \text{ is } 300 \cdot \frac{1}{10}, \text{ or } 30.$$

$$5\% \text{ of } 300 \text{ is } 30 \cdot \frac{1}{2}, \text{ or } 15.$$

$$1\% \text{ of } 300 \text{ is } 15 \cdot \frac{1}{5}, \text{ or } 3.$$

$$10\% + 10\% + 5\% + 1\%$$

$$30 + 30 + 15 + 3 = 78$$

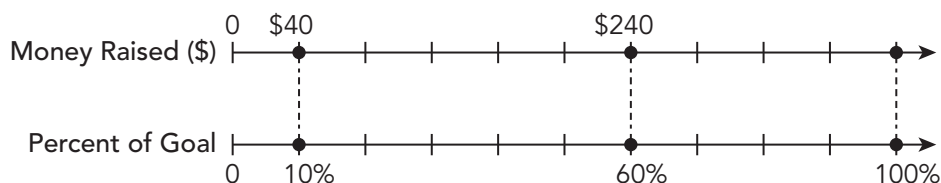
$$26\% \text{ of } 300 \text{ is } 78.$$

### Using Double Number Lines to Solve Percent Problems

Percent problems often have a part, a percent, and a whole. When you know the part and the percent, you can use different strategies to determine the whole.

One strategy is a double number line.

For example, Karla's homeroom raised \$240 for charity, which is 60% of their goal. Karla uses a double number line to record the amount of money raised and the percent of the goal raised.



To determine the value that corresponds to 10%, Karla divided the amount raised so far by 6:  
 $\$240 \div 6 = \$40$ .


Since  $10\% \cdot 10 = 100\%$ , she can multiply \$40 by 10 to determine the homeroom's goal:  
 $\$40 \cdot 10 = \$400$ .



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### Topic 3: Unit Rates and Conversions

Key Terms	
• convert	• unit rate
<p>To <b>convert</b> a measurement means to change it to an equivalent measurement in different units.</p> <p>To convert 36 inches to feet, you can multiply:</p> $36 \cancel{\text{in}} \left( \frac{1 \text{ ft}}{12 \cancel{\text{in}}} \right) = \frac{36 \text{ ft}}{12}$ $= 3 \text{ ft}$	<p>A <b>unit rate</b> is a comparison of two different measurements in which the numerator or denominator has a value of one unit.</p> <p>The speed 60 miles in 2 hours can be written as a unit rate:</p> $\frac{60 \text{ mi}}{2 \text{ h}} = \frac{30 \text{ mi}}{1 \text{ h}}$ <p>The unit rate is 30 miles per hour.</p>
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### Unit Conversions

Students learn that converting within systems of measurement involves the use of conversion rates, another special type of ratio. To convert units of measurement, they use double number lines, ratio tables, scaling up or down, and unit analysis.

The table below lists common conversions written as ratios. They are also listed symbolically using the equal sign.

Ratio Language	Symbolically
For every 12 inches, there is exactly 1 foot.	12 in = 1 ft
For every yard, there are 36 inches.	1 yd = 36 in
For every mile, there are 1760 yards.	1 mi = 1760 yd
For every meter, there are 1000 millimeters.	1 m = 1000 mm
For every 1 kilometer, there are exactly 1000 meters.	1 km = 1000 m



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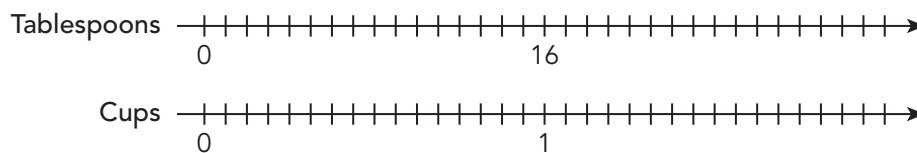


### Using Double Number Lines to Convert Units

When your student learned about ratios and percents in the previous topics, they learned to use double number lines to determine equivalent ratios. Double number lines can also be used to convert from one unit to another.

For example, you are baking cookies at your friend's house. After searching the cupboards and drawers, you cannot find the measuring cups, but you can find the tablespoon.

Shown on the double number line is the conversion rate for tablespoons and cups. There are 16 tablespoons in 1 cup.



Use the double number line to determine how many tablespoons are equal to 2 cups and  $\frac{1}{2}$  cup.

Use the double number line to determine the number of cups equal to 24 tablespoons.

### Using a Ratio Table to Convert Units

Using a ratio table is another strategy for converting units. For example, this table represents the ratio of pounds to ounces.

Pounds	1	2	$\frac{1}{4}$	$1\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{8}$	$2\frac{1}{2}$
Ounces	16	32	4	20	8	6	40

+                      =

You can add values in different columns to determine new equivalent rates.

$$32 \text{ oz} + 8 \text{ oz} = 40 \text{ oz, so } 2 \text{ lb} + \frac{1}{2} \text{ lb} = 2\frac{1}{2} \text{ lb.}$$



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### Scaling Up or Down to Convert Units

Scaling up or down is a similar strategy for determining equivalent ratios that can more easily be used to convert from one unit of measurement to another.

For example, you can use scaling up to determine how many ounces are in 2.5 pounds. Because you want to determine the number of ounces for a specific number of pounds, use the conversion rate 1 lb = 16 oz or  $\frac{1 \text{ lb}}{16 \text{ oz}}$ .

Scaling up

$$\frac{1 \text{ lb}}{16 \text{ oz}} = \frac{2.5 \text{ lb}}{? \text{ oz}} \longrightarrow \frac{1 \text{ lb}}{16 \text{ oz}} \xrightarrow{\times 2.5} \frac{2.5 \text{ lb}}{40 \text{ oz}} \xleftarrow{\times 2.5}$$

### Unit Rate

Your student will model the meaning of a unit rate. They solve different unit rate problems, determining which unit rates make sense in a situation.

For example, unit rates are helpful when solving problems about constant speeds. Suppose Sara can ride 50 miles in 4 hours. At this rate, how far will she ride in 7 hours?

Scale down to determine the unit rate.

$$\frac{50 \text{ miles}}{4 \text{ hours}} = \frac{12.5 \text{ miles}}{1 \text{ hour}}$$

Then scale up to determine the equivalent rate needed to solve the problem.

$$\frac{12.5 \text{ miles}}{1 \text{ hour}} = \frac{87.5 \text{ miles}}{7 \text{ hours}}$$



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## Scenarios, Tables and Graphs

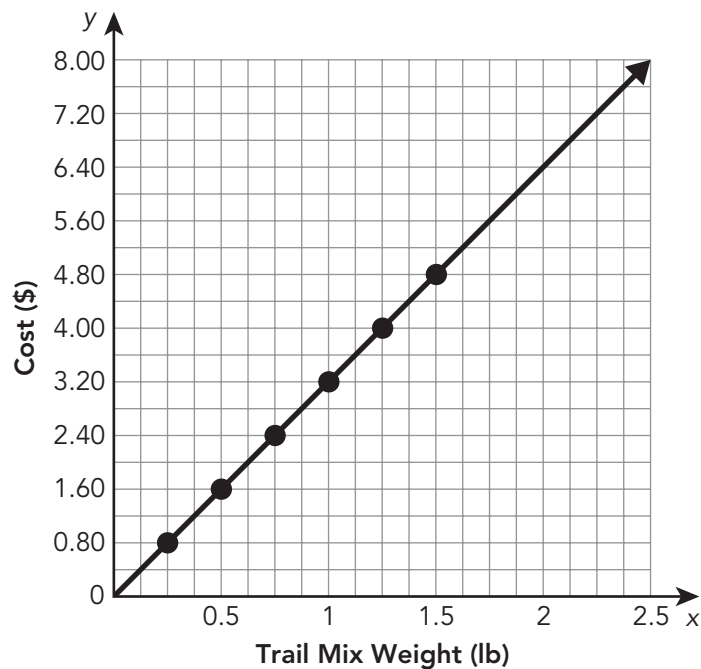
Finally, your student will analyze scenarios and identify the unit rates from tables and graphs.

For example, the 6th grade chorus is selling bags of trail mix to raise money for a trip. The group wants the ratio of cost-to-pounds to stay the same no matter the size of the bag. Each bag costs \$3.20.

The table shows the cost for different quantities of trail mix.

Trail Mix Weight (lb)	Cost (\$)
0.25	0.80
0.5	1.60
0.75	2.40
1	3.20
1.25	4.00
1.5	4.80

The ratios are plotted on the graph and connected with a line.



The graph displays equivalent rates because each ordered pair that falls on the line is a multiple of  $(x, y)$  and is equivalent to the ratio  $\frac{y}{x}$ .

You can use the graph to determine that the unit rate cost : weight is \$3.20 per pound and that the unit rate weight : cost is about 0.3 pound per dollar.



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Discuss important dates throughout this module such as assessments, assignments, or class events with your student. Use the table to record these dates and reference them as your student progresses through the module.

Important Dates	
Date	Reason

Using the link below, visit the Texas Math Solution Support Center for students and caregivers to access additional resources such as:

- Mathematics Glossaries
- Videos
- Topic Materials
- A Letter to Families and Caregivers



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