

Connect Ratios, Rates, and Unit Rates

KEY CONCEPTS

Mathematics Objectives

- Use ratios and rates to describe the relationship between two quantities.
- Find equivalent ratios and use unit rates to solve multi-step problems.

Language Objective Verbally describe how to use ratio concepts and reasoning to solve multistep problems.

Essential Understanding Equivalent ratios and unit rates can be used to compare ratios and solve problems.

COHERENCE

In Grade 6, students:

- learned the concepts of ratios and rates.
- used math models and ratio reasoning to solve problems.

In this lesson, students:

- solve multi-step problems using ratios, rates, and unit rates.
- make comparisons using equivalent ratios and unit rates.

Later in this topic, students will:

- find the unit rate of a ratio involving fractions.
- use equivalent ratios to determine if two related quantities are proportional.

BALANCE

Conceptual Understanding Students understand and reason about ratios and rates and make comparisons with unit rates.

Application Students apply what they know about equivalent ratios and unit rates to solve multi-step problems in real-world situations.

Reinforce Vocabulary

- ratio
- rate
- unit rate

Materials

- two-color counters

Student Resources

 Family Engagement

Intervention System (IS)

M29 Comparing Rates

Teacher Resources

 Editable Lesson Plan

 Lesson Presentation Slides

 enVision on the Go: Planning Support



Texas Essential Knowledge and Skills (TEKS)

Proportionality. The student applies mathematical process standards to represent and solve problems involving proportional relationships. The student is expected to:

7.4A* represent constant rates of change in mathematical and real-world problems given pictorial, tabular, verbal, numeric, graphical, and algebraic representations, including $d = rt$

7.4B calculate unit rates from rates in mathematical and real-world problems

*Readiness Standard

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Mathematical Process Standards

The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

7.1D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate

Language Support

Use this activity before beginning Example 1 to remind students what they already know about unit rates.

Connection to Prior Knowledge

Invite students to write examples of unit rates on the board. After each one, ask the student to say aloud the unit rate. You may wish to model some examples, such as:

$\frac{18 \text{ miles}}{1 \text{ gallon}}$	Eighteen miles per gallon
$\frac{\$1.25}{1 \text{ ounce}}$	One dollar and twenty-five cents per ounce
$\frac{25 \text{ students}}{1 \text{ classroom}}$	Twenty-five students per classroom

- What do the descriptions of all the unit rates have in common? Lead students to say that the word *per* means “for each” and that all unit rates are for each 1 unit.

Invite students to take turns circling the 1 in the denominator as they repeat the language describing it, such as *per gallon*, *per ounce*, or *per classroom*.

An additional activity is available online.

- Use the Productive Language activity with Example 3.

Math Talk Available on Savvas Realize®

Algebra String

Look for a pattern.

$$\begin{array}{r} \frac{8}{5} \\ \frac{16}{10} \\ \frac{32}{20} \\ \frac{n}{100} \end{array}$$

TEKS 7.4A*

Number Fluency Looking for patterns in ratios presented as fractions prepares students for making connections among ratios, rates, and unit rates. Use this Math Talk at the beginning of the lesson.

The numerical expressions are equivalent ratios. Invite students to explain how the values in each ratio change from one expression to the next. Ask:

- How does the value in the first term of the ratios change from one to the next?
- How does the value in the second term of the ratios change from one to the next?
- What is different about the last ratio? How could you find the value of *n*?

If time allows, invite students to generate other strings of equivalent ratios.

Exit Ticket

Formative Assessment

Name **Use this Exit Ticket anytime after Example 1.**

Exit Ticket Lesson 2-1

1. Abby and Daniela have summer jobs at the local recycling plant. They receive their paychecks for the first week. Abby worked 8 hours and earned a total of \$124. Daniela worked 11 hours and earned a total of \$169.40. Which proportion represents how to find Abby's pay per hour?

☒ A $\frac{124}{8} = \frac{15.50}{1}$

☐ B $\frac{15.50}{8} = \frac{124}{1}$

☐ C $\frac{169.50}{9} = \frac{15.40}{1}$

☐ D $\frac{15.40}{9} = \frac{169.50}{1}$

Self-Assessment

Select how well you understand what you learned in this lesson.

Math Goal I can use ratio concepts and reasoning to solve multi-step problems.	☐ Got it	☐ Need help	☐ Working on it
Language Goal I can verbally describe how to use ratio concepts and reasoning to solve multistep problems.	☐ Got it	☐ Need help	☐ Working on it

Teacher Answer Key 1 of 1 Copyright © Savvas Learning Company LLC. All Rights Reserved.

TEKS 7.4B, DOK 2, Math Process 7.1F

You can use the Assessment Sourcebook version or the auto-scored version on Savvas Realize®.

Responses will show whether students understand how to connect ratios and set up a proportion.

As students solve word problems, help them to focus their attention on the key information and to ignore extraneous information. Ask:

- Which information in the problem is not needed to solve it?
- What is the question asking you to find?

English Language Proficiency Standards (ELPS)

SPEAKING 2B The student is expected to speak using content-area vocabulary during formal and informal classroom interactions to demonstrate acquisition of new words and high-frequency words.

College and Career Readiness Standards (CCRS)*

VII.B.1 Use proportional reasoning to solve problems that require fractions, ratios, percentages, decimals, and proportions in a variety of contexts using multiple representations.

Also **II.D.2**

*Standards in **VII** Problem Solving and Reasoning, **VIII** Communication and Representation, and **IX** Connections are infused throughout the program.

Step 1 Explore and Share | ENGAGE & EXPLORE



15-20 min



Explore and Share



Scout Observational Assessment

Connect Ratios, Rates, and Unit Rates

I can ... calculate unit rates to solve multi-step problems.

TEKS 7.4B Calculate unit rates from rates in mathematical and real-world problems. Also, 7.4A Mathematical Process Standards 7.1A, 7.1B, 7.1D, 7.1E, 7.1G

Let's Build

Lesson
2-1

Explore and Share

In a basketball contest, Elizabeth makes 9 out of 25 free throw attempts. Alex makes 8 out of 20 free throw attempts. Janie says that Elizabeth has a better free-throw record because she has more free throws than Alex.



A. Evaluate Reasonableness Do you agree with Janie's reasoning? Explain.

Learn Together Offer help to others and seek help when needed.

B. Justify Math Arguments Decide who has the better free-throw record. Justify your reasoning using mathematical arguments.

Justify Math Arguments What mathematical model could you use to justify your reasoning? Are there other models you could use to represent the situation?

Sample answer: I could use tables of equivalent ratios to represent the situation and compare the ratios. I could also use an equation to find equivalent ratios.

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Sample Student Work

Elizabeth

$$\frac{9}{25} = 0.36$$

Alex

$$\frac{8}{20} = 0.4$$

Angela's Work

Angela writes each ratio as a decimal to compare the free-throw records.

Alex had a better free-throw record. The ratio tables show the free-throw records as equivalent ratios. Alex's record is equivalent to $\frac{40}{100}$, which is greater than $\frac{36}{100}$.

Elizabeth's Free Throw Record		
Baskets Made	9	36
Free Throw Attempts	25	100

Alex's Free Throw Record		
Baskets Made	8	40
Free Throw Attempts	20	100

Kyle's Work

Kyle uses ratio and rate reasoning to construct arguments about the relationship between the number of free throws each player attempts and the baskets each makes.

Explore and Share



Formative
Assessment

Purpose Students explore finding equivalent ratios to compare ratios in Visual Learning Example 1.

Introduce WHOLE CLASS

Ask: Have you ever taken free throws in gym class?

How many free throws do you think you could make out of 20?

Monitor, Select, and Sequence SMALL GROUPS

Observe students at work.

- What methods do students use to find and compare equivalent ratios?** Students might use a ratio table to calculate and compare equivalent ratios. Other students might divide and compare the decimal numbers. If needed, ask: *How do you compare rational numbers?*

Early Finishers

Ask: If Elizabeth made 10 baskets in 25 attempts, would she have the better free-throw record? [No; The players would be tied.]

Connect WHOLE CLASS

Connect Solution Strategies Have students first discuss the mistake they believe Janie made; she only compared the number of baskets made. Then have students present how they compared the ratios correctly. Have students who use equivalent ratios or ratio tables present first and those who used decimals or percentages present second.

Write solutions on the board and have students discuss how the decimals, percentages, and the equivalent ratios are related.

When presenting Example 1, connect the strategy of unit rates to the strategy of equivalent ratios in the Explore and Share. Both strategies found equivalent ratios with the goal of comparing two values with the same whole (shots taken and hours). Ask students to consider how they would have solved the Explore and Share problem using unit rates. Elizabeth's unit rate is $\frac{9 \text{ made}}{25 \text{ attempted}} = 0.36$ made per attempted shot.

Alex's unit rate is $\frac{8 \text{ made}}{20 \text{ attempted}} = 0.4$ made per attempted shot.

Compare the unit rates. Alex has a better free throw record.

Learn Together

Offer Help to Others Doing math and thinking about math is not always easy. Ask:

- What can you say to help others feel confident?
- What can you do to help others persevere?
- How can you support discouraged classmates?

Step 2 Visual Learning | EXPLAIN



40-45 min

Visual Learning Animation

Essential Question How can you use ratios, rates, and unit rates to solve problems?

Visual Learning

Example 1 Find Unit Rates
Use the paychecks to calculate a unit rate of earning per hour for both Dan and Nathan.

Park Services EARNINGS STATEMENT	
EMPLOYEE	Dan Jones
HOURS	9
TOTAL EARNINGS	\$141.75

Park Services EARNINGS STATEMENT	
EMPLOYEE	Nathan Smith
HOURS	5
TOTAL EARNINGS	\$81.25

Connect Math Ideas You can use a ratio to relate the number of hours that Dan and Nathan each work and the amount each of them earns.

Draw a model to show how the quantities are related.

Find each unit rate for 1 hour.

Nathan's Pay
\$81.25 → ?
5 hours → 1 hour

Dan's Pay
\$141.75 → ?
9 hours → 1 hour

Try It! Jennifer's paycheck shows \$242.25 for 15 hours of work. Calculate two unit rates with the paycheck information. Round to the nearest hundredth.
\$16.15/1 hour, 0.06 hr/\$1

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Essential Question

Engage students in a discussion about the **Essential Question**. Make sure students understand ratio and rate concepts that they learned in Grade 6.

Example 1 Find Unit Rates

- How were the equivalent ratios generated? [Divide the two terms in the given ratio by the same number.]
- Why is it important to find the unit rates for each conservationist's pay? [It makes it easier to compare their pay when you find the amount each earns in 1 hour.]
- Suppose you found equivalent ratios for Nathan and Dan with the same total earnings. How could you use those ratios to compare Nathan's and Dan's pay? [Because the earnings are the same, you can just compare the number of hours worked to determine who makes more.]

Try It!

- What information does the problem statement give you? [the amount of money Jennifer makes for working 15 hours]
- Of the three conservationists, who makes the most money? Explain. [Nathan; he makes \$0.10 more per hour than Jennifer, who makes \$0.40 more per hour than Dan.]

Language Support Use the activity found in the Lesson Opener.

Targeted ELPS Support SPEAKING 2B

Pre-Production Read the example aloud to students, including the parts.

- In what part of the solution is the unit rate calculated?

Beginning Read the example aloud to students, including the parts.

- What are *earnings*?
- Where do you see each employee's *earnings*?

Intermediate Read the example aloud to students, including the parts.

- What does the word *equivalent* mean?
- Name two *equivalent* ratios in the example.

High Intermediate Complete Example 1.

- Name a pair of *equivalent* ratios in the example.
- Which ratio is the unit rate? Explain in your own words the meaning of a unit rate.

Advanced Complete Example 1.

- Why are $\frac{81.25}{5}$ and $\frac{16.25}{1}$ equivalent ratios?

Help students internalize academic language by using vocabulary correctly in their answers.

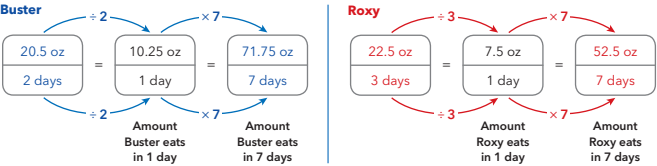
- How can you use equivalent ratios to find a unit rate?
- Give examples of other unit rates you have used.

Step 2 Visual Learning *continued* | EXPLAIN

Example 2 Use Unit Rates

Brian agrees to watch his neighbor's dogs for 7 days. His neighbor supplies a 128-ounce bag of dog food. Does Brian have enough food to feed the dogs all 7 days? Explain.

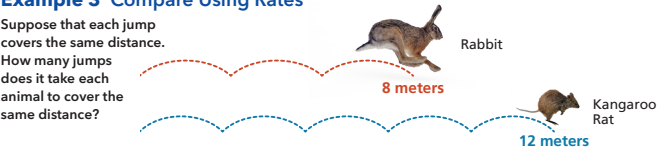
STEP 1
Use unit rates to find how much each dog eats in 7 days.



STEP 2
Find the total amount of dog food that Brian needs for 7 days. Then compare.
 $71.75 + 52.5 = 124.25$ and $124.25 < 128$, so Brian has enough dog food.

Example 3 Compare Using Rates

Suppose that each jump covers the same distance. How many jumps does it take each animal to cover the same distance?



Make tables of equivalent ratios until the distance jumped is the same.

Rabbit		Kangaroo Rat	
Jumps	Meters	Jumps	Meters
3	8	5	12
6	16	10	24
9	24		

The rabbit jumps 24 meters in 9 jumps.
The kangaroo rat jumps 24 meters in 10 jumps.

Try It! A kitchen sink faucet streams 0.5 gallon of water in 10 seconds. A bathroom sink faucet streams 0.75 gallon of water in 18 seconds. Which faucet can fill a 3-gallon container faster?

The kitchen sink fills a 3-gallon container in 60 seconds, faster than the bathroom sink, which fills the container in 72 seconds.

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Example 2 Use Unit Rates

- What is the ratio of food to number of days for Roxy? For Buster? $\left[\frac{22.5}{3}, \frac{20.5}{2}\right]$
- How does knowing the unit rate of each dog's food consumption help you make a decision? [The unit rate is how much each eats in one day, so you can multiply to find the amount each dog will eat in a week.]

Language Routine: Stronger and Clearer Each Time

Have students explain how to determine the solution in Example 2. Encourage students to listen to one another's explanation and offer suggestions for how to streamline the explanation to make it clearer. Students should collaborate on a final explanation of how to find the solution.

Example 3 Compare Using Rates

- How were the equivalent ratios in the tables generated? [Multiply the two terms in the given ratio by the same number.]
- Why is it important to extend the ratio tables until the number of jumps or the distance jumped is the same? [It is easier to compare the ratios when one of the quantities is the same number.]

Try It!

- How do you find the unit rate of gallons per second for each faucet? [Divide the number of gallons by the number of seconds.]
- How could you use equivalent ratios for this problem? [Use the unit rates to determine which faucet will fill a container faster.]

Support Student Understanding

Example 2 Review equivalent ratios and unit rates.

- Remind students that they can find equivalent ratios using multiplication or division.

Find a ratio that is equivalent to $\frac{25}{10}$. $\left[\frac{250}{100}, \frac{5}{2}\right]$

- Have students find equivalent ratios with a second term of 1.

Find a ratio with a second term of 1 that is equivalent to $\frac{35}{7}$. $\left[\frac{5}{1}\right]$

- Make sure students understand that a unit rate is one of many equivalent ratios that they can find.

Extend Student Thinking

Example 3 Challenge students to determine how many jumps it would take for each animal to travel 26.7 meters.

- Determine the unit rate for each animal. [Rabbit: $\frac{8}{3} = 2.67$ m per jump; kangaroo rat: $\frac{12}{5} = 2.4$ m per jump]
- How can you generate an equivalent ratio with a distance of 26.7 meters for the rabbit? [Multiply the unit rate by 10.]
- How can you determine the number of jumps for the kangaroo rat? [Divide 26.7 meters by the distance quantity in the kangaroo rat's unit rate. $26.7 \div 2.4 \approx 11.1$.]

Key Concept

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You can use equivalent ratios and rates, including unit rates, to compare ratios and to solve problems.

Talk About Math Ideas

Is a unit rate helpful in a non-proportional relationship? Why or why not? When might a unit rate be helpful in a non-proportional relationship?

Do You Understand?

1. Essential Question

How can you use ratios, rates, and unit rates to solve problems?

Sample answer: I can use ratios or rates to represent related quantities with the same or different units in a problem. Then I can divide or multiply to find unit rates and other equivalent ratios. Unit rates can also make it easier to compare two or more ratios.

2. Apply Math

Dorian buys 2 pounds of almonds for \$21.98 and 3 pounds of dried apricots for \$26.25. Which is less expensive per pound? How much less expensive?

Complete the tables of equivalent ratios to help you solve.

Almonds		Dried Apricots	
Cost	Weight (lb)	Cost	Weight (lb)
\$21.98	2	\$26.25	3
\$10.99	1	\$8.75	1

The dried apricots are less expensive, by \$2.24 per pound.

3. Connect Math Idea

How are unit rates and equivalent ratios related?

Sample answer: A unit rate and any other equivalent ratio represent the same relationship between the two quantities in the given ratio.

Do You Know How?

4. Krystal is comparing two Internet service plans. Plan 1 costs \$34.99 per month. Plan 2 costs \$134.97 every 3 months. If Krystal plans to stay with one service plan for 1 year, which should she choose? How much would she save?

Plan 1; She would save \$120 over 1 year.

5. Pam reads 126 pages of her summer reading book in 3 hours. Zack reads 180 pages of his summer reading book in 4 hours. If they continue to read at the same speeds, can they both finish the 215-page book after 5 total hours of reading? Explain.

Pam can read 210 pages in 5 hours, so she can not finish the book. Zack can read 225 pages in 5 hours, so he can finish the book.

6. Nora and Eli are making homemade spring rolls for a party. Nora can make 8 spring rolls in 10 minutes. Eli can make 10 spring rolls in 12 minutes. If they each make 40 spring rolls, who finishes first?

Nora can make 40 spring rolls in 50 minutes. Eli can make 40 spring rolls in 48 minutes. Eli finishes first.

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Key Concept

- How do equivalent ratios and unit rates help you compare ratios and solve problems? [To compare two ratios, you can generate equivalent ratios with one term that matches. Compare the other terms of those equivalent ratios. Unit rates allow analyses to be made with ratios compared to 1 unit.]

Talk About Math Ideas

Have students discuss the response to the question in small groups. Listen for conversations that mention not being able to use ratios equivalent to the unit rate in a non proportional relationship to be able to determine or compare other ratios in the situation. An example of this is when there is a discount for buying more of an item.

Do You Understand/Do You Know How?

Essential Question

Students should understand that ratios and rates both relate two quantities. Rates are a type of ratio that relates quantities with different units. A unit rate relates a quantity to one unit of another quantity.

Item 3

- What types of problems have you solved using equivalent ratios? [Comparing two basketball players’ free-throw abilities]
- What types of problems have you solved using unit rates? [Deciding if you have enough dog food; comparing the lengths of animals’ jumps]

Prevent Misconceptions

Item 4 If students start by comparing \$134.97 for Plan 2 with \$34.99 for Plan 1, remind them that when comparing Internet service plans, they must compare the cost for the same number of months for each plan.

- What is the unit rate for Plan1? For Plan 2? $\left[\frac{\$34.99}{1}, \frac{\$44.99}{1}\right]$

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EP

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/104/SA01594_TE/enVisionMath/TX/TE/enVisionMath_2027/G7/XXXXXXXXXX/Layout/Interio ...

Step 3 Practice and Problem Solving | ELABORATE



15-20 min



Interactive Practice



Adaptive Practice

Name _____

Practice and Problem Solving

In 7-8, complete the tables of equivalent ratios to solve.

7. After Meghan walks 5 miles, her activity tracker counts 9,780 steps. David's activity tracker counts 11,928 steps after he walks 6 miles. Suppose that each person's step covers a constant distance. Who takes more steps to walk 1 mile? How many more steps?

David; 32 more steps

Meghan's Steps		David's Steps	
Steps	Miles	Steps	Miles
9,780	5	11,928	6
1,956	1	1,988	1

8. What is the unit rate of dollars for 1 pair of gloves if 5 pairs of gloves cost \$29.45?

\$5.89/1 pair of gloves

Price	Pairs of Gloves
\$29.45	5
\$5.89	1

9. Calculate the per-ounce unit rate for each package of rice.

**Yellow Bag: \$0.35/1 oz,
Blue Box: \$0.38/1 oz,
Green Bag: \$0.37/1 oz**



10. A nursery owner buys 5 panes of glass to fix some damage to her greenhouse. The 5 panes cost \$14.25. Unfortunately, she breaks 2 more panes while repairing the damage. What is the cost of another 2 panes of glass?

\$5.70

11. **Communicate Math Ideas** An arts academy requires there to be 3 teachers for every 75 students and 6 tutors for every 72 students. How many tutors does the academy need if it has 120 students?

10 tutors

12. **Analyze Math Relationships** In large cities, people often take taxis to get from one place to another. What is the cost per mile of a taxi ride? How much is a 47-mile taxi ride?

\$0.70 per mile; \$32.90



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You may opt to have students complete automatically scored practice items online.

13. The Largo Middle School track team needs new uniforms. The students plan to sell plush toy tigers (the school mascot) for \$5. The students find three companies online that sell stuffed mascots.

- a. Which company has the lowest cost per tiger?

Company C

- b. If they use that company, how much profit can the students make for each tiger sold?

\$2.26

Company A
12 tigers for \$33.24



Company C
15 tigers for \$41.10



Company B
16 tigers for \$44.80

14. A contractor purchases 7 dozen pairs of padded work gloves for \$103.32. He incorrectly calculates the unit price at \$14.76 per pair.

- a. What is the correct unit price?

\$1.23 per pair

- b. **Critique Reasoning** What error did the contractor likely make?

The contractor's unit price is per dozen pairs, not per pair of gloves.

15. **Higher Order Thinking** A warehouse store sells 5.5-ounce cans of tuna in packages of 6. A package of 6 cans costs \$9.24. The store also sells 6.5-ounce cans of the same tuna in packages of 3 cans for \$4.68. It also sells 3.5-ounce cans in packages of 4 cans for \$4.48. Which package has the lowest cost per ounce of tuna?

A package of the 6.5-oz cans has the lowest unit price.

STAAR Assessment Practice

16. Lena is making two dishes for an event. Each batch of her mac-and-cheese recipe calls for 6 ounces of cheese and 2 tablespoons of basil. For every two pizzas, she needs 16 ounces of cheese and 5 tablespoons of basil. 7.4B

PART A

Lena buys a 32-oz package of cheese. Does she have enough cheese to make 2 batches of mac-and-cheese and 3 pizzas? Explain.

Lena does not have enough cheese. 2 batches of mac-and-cheese require 12 ounces of cheese. 3 pizzas require 24 ounces of cheese. Lena needs 36 ounces of cheese in total.

PART B

Lena decides to make 1 batch of mac-and-cheese and 3 pizzas. How many tablespoons of basil does she need? Explain your answer.

9.5 tablespoons; 1 batch of mac-and-cheese requires 2 tablespoons of basil. 3 pizzas require 7.5 tablespoons of basil.

17. It costs Irene \$58.90 to fill her car's gas tank with $15\frac{1}{2}$ gallons of gas. Select all the rates that are equivalent to \$58.90 for $15\frac{1}{2}$ gallons of gas. 7.4A

- ☒ \$41.80 for 11 gallons of gas
☐ \$28.80 for 8 gallons of gas
☒ \$26.60 for 7 gallons of gas
☐ \$8.55 for 2 gallons of gas
☒ \$3.80 for 1 gallon of gas

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Practice and Problem Solving

Engage Through Student Choice

Go online for an assignment strategy.

Error Intervention

Item 14 Help students find the unit rate for each pair of gloves.

- How many pairs of gloves did the contractor buy? [7 dozen or 84 pairs of gloves]
- How would you find the correct unit rate? [Divide the total cost of \$103.32 by 84.]

Challenge

Item 15 Use this item to extend students' understanding of unit price.

- Would it be efficient to use equivalent ratios to solve this problem? [No, trying to find the LCM of the prices, or the total number of ounces, is difficult.]
- How will you approach this problem? [Find the number of ounces in each package, then the cost per ounce.]

Item Analysis: Practice and Problem Solving

Example	Item	DOK	TEKS	
			Content	Process
1	8, 9	2	7.4B	
2	11	1	7.4A	7.1D
	12	2	7.4A	7.1F
	10, 17	2	7.4A	
	14, 16	3	7.4B	
3	7	1	7.4B	
	13, 15	2	7.4B	

Quick Check



- Assess lesson content with the Quick Check.
- The online Quick Check is **automatically scored** and **remediation, practice, or enrichment** will be assigned based on student performance.
- You can use the Assessment Sourcebook version to prescribe targeted remediation or enrichment.

Item	DOK	TEKS	
		Content	Process
1	2	7.4B	
2	2	7.4B	
3	2	7.4B	
4	2	7.4B	
5	2	7.4B	

0-3 points: Intervention Activity (below) and Reteach to Build Understanding Activity

4-5 points: Enrichment Activity

In addition, **emergent bilingual students** may benefit from the Build Mathematical Literacy Activity.

Differentiation Library DL

- Additional Differentiation Library resources are described at the start of this topic.
- Differentiation resources that support diverse learning styles are online and in the Differentiation Library Teacher’s Guide.

Video Tutorials Available on Savvas Realize®

Students can access these tutorials anytime to reinforce lesson content.

- How Do You Solve a Word Problem Using Unit Rates?
- How Do You Use Unit Rates to Compare Rates?

Item Analysis: Additional Practice

Example	Item	DOK	TEKS	
			Content	Process
1	1, 2	1	7.4A	
	5	2	7.4B	
2	4, 8	1	7.4A	
	10	2	7.4A	
3	3	1	7.4B	
	6, 11	2	7.4B	
	7, 9	3	7.4A	

Additional Practice

Printable or autoscored on Savvas Realize®

2-1 Additional Practice

In 1-3, complete the tables of equivalent ratios to solve.

1. There are 3 boys for every 6 girls at a movie. If there are 24 girls, how many boys are at the movie?

Boys	Girls
3	6
12	24

There are **12** boys at the movie.

2. What is the unit rate of dollars for one trading card?

Price	Trading Cards
\$5.25	25
\$0.21	1

\$0.21/1 trading card

3. A car travels 374 meters in 17 seconds. A bus travels 414 meters in 23 seconds. Which vehicle is traveling faster? How much faster?

Car		Bus	
Meters	Seconds	Meters	Seconds
374	17	414	23
22	1	18	1

The **car** is traveling faster.
It is traveling faster by **22 - 18 = 4** meters per second.

4. In a toy store, the ratio of dolls to teddy bears is 9:3. If the store has 240 dolls, how many teddy bears are in the store?
80 teddy bears

5. An airplane on autopilot took 5 hours to travel 3,475 kilometers. What was the airplane's speed, in kilometers per hour?
695 kilometers per hour

6. **Analyze Math Relationships** At a supermarket, a 6-ounce bottle of salad dressing costs \$1.56. A 14-ounce bottle costs \$3.36. A 20-ounce bottle costs \$5.60. Calculate the per ounce unit rate for each bottle.
6-ounce bottle: \$0.26/1 ounce, 14-ounce bottle: \$0.24/1 ounce, 20-ounce bottle: \$0.28/1 ounce

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7. During a thunderstorm, 600 millimeters of rain fell in 30 minutes.

a. How fast did the rain fall, in millimeters per minute?
20 millimeters per minute

b. How fast did the rain fall, in millimeters per hour?
1,200 millimeters per hour

c. **Justify Math Arguments** Which unit rate do you think is more useful? Explain your reasoning.
Sample answer: The unit rate in millimeters per minute is more helpful because it makes it easier to calculate how much rain fell at certain points during the 30-minute thunderstorm.

8. Population density is the number of people per unit of area. The population density of a certain region is 60 people per square kilometer. If the region covers 23 square kilometers, what is the population of the region?
1,380 people

9. **Higher Order Thinking** In basketball, some baskets are worth three points. In one game, the ratio of three-point baskets made to three-point attempts for one team was 3:4. If the team scored 27 points from three-point baskets, how many three-point attempts did the team have?
12

STAAR Assessment Practice

10. Allen is mixing red and yellow paints to make two different shades of orange. To make 1 cup of dark orange paint, he needs 7 ounces of red paint and 1 ounce of yellow paint. To make 2 cups of light orange paint, he needs 13 ounces of yellow paint and 3 ounces of red paint.

PART A
Allen buys a 32-ounce can of red paint. Does he have enough red paint to make 3 cups of dark orange paint and 3 cups of light orange paint? Explain.
Yes; 3 cups dark orange require 21 ounces; 3 cups light orange require 4.5 ounces; 21 + 4.5 = 25.5 ounces

PART B
Allen decides to make 3 cups of dark orange paint and 3 cups of light orange paint. How many ounces of yellow paint does he need? Explain.
22.5 ounces; 3 cups dark orange require 3 ounces; 3 cups light orange require 19.5 ounces; 3 + 19.5 = 22.5 ounces

11. A covered bridge is 8 yards long. In a photograph for sale at a gallery, the bridge is $\frac{1}{8}$ foot long. Which statements are true?

☐ One yard of the covered bridge is represented by 1.6 inches in the photograph.

☒ One inch on the photograph represents 1.6 yards of the real bridge.

☒ A tree that is 3 inches tall in the photograph is 4.8 yards tall.

☐ The people walking over the bridge are about 2.5 inches tall in the photograph.

☒ A river that is 12 yards wide is 7.5 inches wide in the photograph.

12 2-1 Connect Ratios, Rates, and Unit Rates

Let's Investigate
Lesson
2-3

Understand Proportional Relationships

KEY CONCEPTS

- Mathematics Objective**
- Determine whether quantities are proportional by testing for equivalent ratios.
- Language Objective** Describe how to test for equivalent ratios and explain, orally and in writing, whether quantities are in a proportional relationship.
- Essential Understanding** Quantities in a proportional relationship can be described by equivalent ratios.

COHERENCE

- In Grade 6, students:**
- found equivalent ratios.
 - used ratio and rate reasoning to solve real-world problems.
- In this lesson, students:**
- look for equivalent ratios to identify proportional relationships.
 - use proportions to solve problems.
- Later in this topic, students will:**
- use the constant of proportionality to write equations for proportional relationships and graph a line through the origin.
 - decide whether they can use proportional reasoning to solve given problems.

BALANCE

- Conceptual Understanding** Students extend their prior understanding of a unit rate and explore its relationship to equivalent ratios.
- Application** Students look for equivalent ratios to determine if a relationship is proportional.

New Vocabulary

- proportional relationship
- proportion

Materials

- centimeter grid paper
- centimeter ruler

Student Resources

- Family Engagement

Intervention System (IS)
M35 Solving Proportions

Teacher Resources

- Editable Lesson Plan
- Lesson Presentation Slides
- Slow Reveal Slides
- Sample Student Work
- Exit Ticket and Teacher Support
- Using Manipulatives: Understand Proportional Relationships: Equivalent Ratios
- enVision on the Go: Planning Support



Texas Essential Knowledge and Skills (TEKS)

The student applies mathematical process standards to represent and solve problems involving proportional relationships. The student is expected to:

7.4D* Solve problems involving ratios, rates, and percents, including multi-step problems involving percent increase and percent decrease, and financial literacy problems.

Also 7.7A*

*Readiness Standard

Mathematical Process Standards

- The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:
- 7.1D** Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.
- 7.1G** Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication.
- Targeted ELPS Support WRITING 4E**
- College and Career Readiness Standards VII.B.1, III.D.3, II.D.2**

Understand Proportional Relationships

I can ... investigate equivalent ratios.

TEKS 7.4D Solve problems involving ratios, rates, and percents, including multi-step problems involving percent increase and percent decrease, and financial literacy problems. Also 7.7A Mathematical Process Standards 7.1B, 7.1D, 7.1E, 7.1F, 7.1G

Let's Investigate

Lesson 2-3

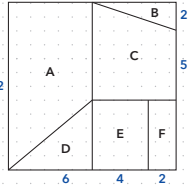


Many careers and hobbies involve the idea of enlarging patterns or designs. For example, architects draw small plans to build larger structures, and artists create small designs that need to be enlarged for public viewing.

An Even Bigger Puzzle

In this activity, you will make a larger puzzle from a smaller drawing. You will know if you have done the enlargement correctly if the new puzzle pieces fit together the same way.

Use the information in this drawing of the puzzle to make a larger version of the puzzle in which the segment labeled 4 in the picture measures 7 cm in the new puzzle. Explain your reasoning.



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Lesson 2-3 61

Explain Math Ideas

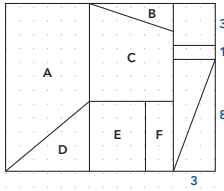
Describe how you determined each measurement for the new puzzle.

Two quantities are in a **proportional relationship** if all of the ratios that relate the quantities are equivalent. A **proportion** is an equation that represents equal ratios.

Do the lengths in the puzzles have a proportional relationship? How do you know?

Connect Math Ideas

The puzzle is expanded to include the rectangular section along the right edge. Write an equation that can be used to figure out the lengths of the new measurements.



Build G.R.I.T. Resilience

If your solution is incorrect, check each step in order for errors. Stay determined to find the correct solution.



62 Lesson 2-3

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Anticipate

Anticipate students’ solution strategies. Think of various ways students will explore and use proportions and proportional relationships to enlarge a drawing of a puzzle. See the next page for sample student work.

Introduce the Investigation WHOLE CLASS

Elevate Student Voice: Engage Students in the Context

- Does anyone know what an architect does?
- What do you think the architect in the photo is doing?

 **Use Reveal Slides** Reveal part of the information. Ask: What do you notice? What do you wonder?

Check for Understanding

Language Routine Collect and Display

Begin by having students discuss their approach to enlarging the puzzle with a partner or group. Encourage them to make sketches and discuss the mathematics involved.

As students discuss, listen for mathematical language and strategies involving proportions and proportional reasoning. Copy students’ vocabulary, strategies, and sketches onto the board.

Finally, review the thinking as a class. As students see the representations created by their classmates, they can address similarities and differences, encouraging them to find the most precise strategies to solve the problem.

Lesson 2-3 61-62

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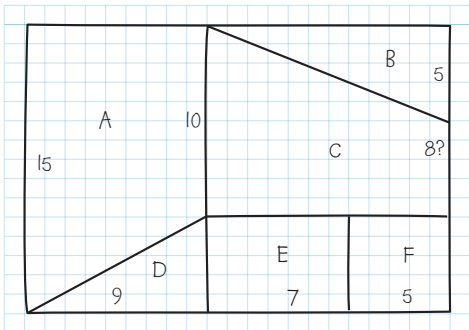
/104/SA01594_TE/enVisionMath/TX/TE/enVisionMath_2027/G7/XXXXXXXXXX/Layout/Interio ...

Step 1 Investigate *continued*

Sample Student Work Available on Savvas Realize®

Student 1 Work

- incorrectly adds 3 to each measurement

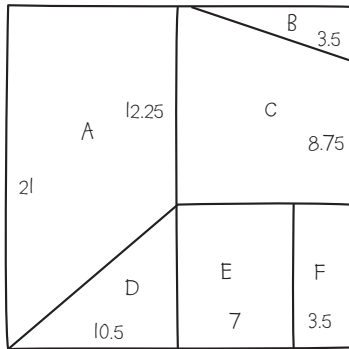


The difference from 4 to 7 is 3, so we added 3 to each length and then tried to draw it, but one length should be 8 long and there were only 5 squares left for it.

Ask: Adding 3 to 4 is almost doubling the measurement. Is adding 3 to 12 also almost doubling the measurement? [The pieces no longer fit together because they are increasing each by the same quantity, not percent.]

Student 2 Work

- correctly multiplies each length by 1.75



We found that to get 7 from 4, we had to multiply 4 by 1.75, so we multiplied every measurement by 1.75 and it worked.

Ask: Why did you decide to multiply 4 by a number to get 7? [All measurements needed to enlarge the same number of times.]

Student 3 Work

- incorrectly relates two ratios

$$\begin{array}{ccccc} \frac{4}{7} = \frac{x}{2} & \frac{4}{7} = \frac{x}{5} & \frac{4}{7} = \frac{x}{6} & \frac{4}{7} = \frac{x}{7} & \frac{4}{7} = \frac{x}{12} \\ 7x = 8 & 7x = 20 & 7x = 24 & 7x = 28 & 7x = 48 \\ x \approx 1.14 & x \approx 2.86 & x \approx 3.43 & x = 4 & x \approx 6.86 \end{array}$$

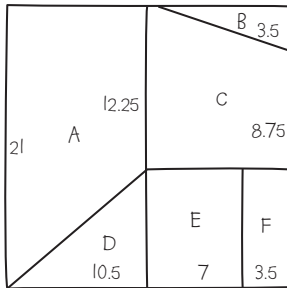
We used a proportion to convert each measurement but it didnt work because the lengths got smaller.

Ask: Do these ratios make sense? [The ratio of 4 to 7 relates the original to the new measurement, so the other ratios should do the same.]

Student 4 Work

- correctly relates two ratios

$$\begin{array}{ccccc} \frac{4}{7} = \frac{2}{x} & \frac{4}{7} = \frac{5}{x} & \frac{4}{7} = \frac{6}{x} & \frac{4}{7} = \frac{7}{x} & \frac{4}{7} = \frac{12}{x} \\ 4x = 14 & 4x = 35 & 4x = 42 & 4x = 49 & 4x = 84 \\ x = 3.5 & x = 8.75 & x = 10.5 & x = 12.25 & x = 21 \end{array}$$



We used the ratio of 4 to 7 to figure out the new lengths and then drew it.

Ask: How did you determine where to put each number in the ratios? [Relate the measurements in the same order—smaller over larger equals smaller over larger, or vice versa.]

Student 5 Work

- correctly writes an equation

$$\text{new length} = \frac{7}{4} \cdot \text{old length}$$

$$n = \frac{7}{4}x$$

$$n = \frac{7}{4} \cdot 3 = \frac{21}{4} = 5\frac{1}{4}$$

$$\frac{7}{4} \cdot 8 = 7 \cdot 2 = 14$$

$$\frac{7}{4} \cdot 1 = \frac{7}{4} = 1\frac{3}{4}$$

Ask: Is using an equation better than using a proportion? [The equation still uses a proportion, with the unknown isolated.]

Step 1 Investigate *continued*

Monitor SMALL GROUP

Monitor Students at Work Ask questions to assess and advance students’ thinking.

Assessing Questions

Questions for Students to Understand Their Thinking

- What operations might you use to enlarge measurements?
- What does the drawing tell you?
- How can you use the relationship between 4 units and 7 cm to enlarge the other measurements?
- Why do you think you can’t complete your puzzle?
- What could you try instead?

Questions for You as You Observe

- Which groups are struggling to relate the given measurements to a new pair of measurements?
- Which groups understand that they can increase each number in a similar way by using multiplication or a ratio?

Advancing Questions

Questions to Ask Students Who Need Help

- What is another operation that you could try?
- How many times greater than 4 is 7?
- How is this like zooming in on/enlarging a picture?

Questions to Help Students Think More Deeply

- How is a scale on a map like what you have done to enlarge the puzzle?

Select and Sequence Solutions

SMALL GROUP

Select and Sequence Students’ Solutions for presentations with the goal of building understanding of key math concepts.

- **Start** with a correct solution that multiplies each measurement by the same number to create the enlargement (Student 2 Work).
- **Then** show solutions that show incorrect strategies (Student 1 and Student 3 Work) and address any misconceptions.
- **Finally**, show other correct solution strategies such as using ratios and equations (Student 4 and Student 5 Work) and connect those representations to proportional reasoning.

Discuss Student Solutions WHOLE CLASS

After allowing students to finish the questions for the lesson, return to an all-class discussion.

- What is an important step in enlarging the puzzle so that the pieces still fit together correctly? [Students should understand that each larger measurement has been increased the same number of times or by using the same ratio.]
- How do you find the missing measurements once you know the ratio? [Students might answer by writing equivalent ratios or by using the ratio as a multiplier for each measurement.]
- How can you recognize a proportional relationship? [Students might answer that the two ratios are equivalent, or they see how the numerator and denominator in one fraction can be easily multiplied by the same number to create the other fraction.]

Targeted ELPS Support WRITING 4E

Pre-Production Review the Connect Mathematical Ideas direction. Read pairs of ratios to students such as $\frac{2}{4}$ and $\frac{3}{6}$. Give a thumbs up if I read equivalent ratios.

Beginning Review the Connect Mathematical Ideas direction. Ask students to name equivalent ratios and ratios that are not. Write *Equivalent* and *Not Equivalent*.

Intermediate Review the Connect Mathematical Ideas direction. Complete these sentences: An equation with equal ratios is a _____. [proportion] Equivalent ratios are _____. [proportional]

High Intermediate Review the Connect Mathematical Ideas direction. Ask students what is an equation with equal ratios and what relationships do quantities have when the ratios are equivalent.

Advanced Review the Connect Mathematical Ideas direction. Have students define ratio, and explain how ratios can be used to identify whether quantities are proportional.

Step 2 Connect



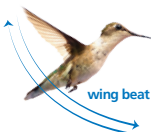
25-30 min

Choose a Problem

A How is the number of game lives awarded related to the number of gems found?



B How many times will the hummingbird beat its wings in 60 seconds?



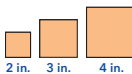
Hummingbird Wing Beats

Seconds (x)	2	7	10
Wing Beats (y)	160	560	800

C Dairy farmers produce milk to support the local economy. Is the ratio of dairy farmers to the number of cows milked proportional? Explain.

x	2	3	5	8
y	5	7.5	12.5	18

D Is the relationship between the area and the side length of the squares proportional? Explain.



Sample Student Work

A. Sample answer: Each ratio $\frac{\text{gems}}{\text{game lives}}$ is equivalent to $\frac{1}{3}$. The number of game lives awarded is proportional to the number of gems found.

B. Sample answer: Verify that the quantities are proportional.
 $\frac{160}{2} = \frac{80}{1}$, $\frac{560}{7} = \frac{80}{1}$, $\frac{800}{10} = \frac{80}{1}$
The ratios are equivalent, so the quantities are proportional.

Write and solve a proportion.

$$\frac{80}{1} = \frac{y}{60}$$
$$\frac{80}{1} \cdot 60 = \frac{y}{60} \cdot 60$$
$$4,800 = y$$

A hummingbird beats its wings 4,800 times in 60 seconds.

C. Sample answer: $\frac{5}{2} = \frac{7.5}{3} = \frac{12.5}{5} = 2.5$, but $\frac{18}{8} = 2.25$, so the ratio of dairy farmers and cows milked is not proportional.

D. Sample answer: The ratios are not equivalent, so the relationship between the area and side length is NOT proportional.

Side Length (x)	Area (y)	$\frac{\text{Area (y)}}{\text{Side Length (x)}}$
2	4	$\frac{4}{2} = \frac{2}{1}$
3	9	$\frac{9}{3} = \frac{3}{1}$
4	16	$\frac{16}{4} = \frac{4}{1}$

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Lesson 2-3 63

Choose a Problem INDIVIDUAL SMALL GROUP

Discuss Solution Strategies

Group students based on the chosen problem to discuss their solution strategies. Consider having groups record their solutions on a vertical surface. Do a gallery walk so they can discuss different problems and solution strategies.

Problem A

- What ratio can you write to compare the number of gems to the number of game lives?

Problem D

Is it necessary to find the area of every square?

Present and Analyze

Prioritize discussion about ratios and proportional relationships. If needed to promote discussion, ask questions such as:

Problem A

- Is the ratio of gems to game lives the same in every column? [Yes. In every column there are 3 game lives for every gem.]

Problem B

- How can you tell how many times the hummingbird will beat its wings in 1 second? [Simplify the ratio in the first column of the table: $\frac{2}{160} = \frac{1}{80}$. The hummingbird beats its wings 80 times in 1 second.]

Problem C

- How can you tell if the relationship is not proportional? [If the relationship is not proportional, the ratio of dairy farmers to cows milked will not be the same in every example.]

Problem D

- How can you use ratios to test if the relationship is proportional? [First find the area of each square and then set up ratios using each side length and area to test if they are equal.]

Engage Students Through Choice

Assist students in selecting a problem to solve individually.

Problem A is for students who are still working on understanding the result of multiplying or dividing by a constant value.

Problem B is for students who need more work on recognizing sets of equivalent ratios.

Problem C is for students who are ready to apply understanding of equivalent ratios in a proportional relationship.

Problem D is for students who understand proportionality and will benefit from using their reasoning to identify a nonproportional relationship.

Early finishers may choose more than one problem.

Step 2 Connect *continued*

Connect

1. **Communicate Reasoning** How was the strategy you used in *Choose a Problem* the same as your strategy in *An Even Bigger Puzzle*? How were your strategies different?

You compare ratios in each problem.

A. The ratios are all equivalent.

B. Since all of the ratios are equivalent, you can apply proportional reasoning.

C. Some ratios were equivalent, but one was not, so the relationship is not proportional.

D. Although there was a pattern, the ratios were not equivalent so there is not a proportional relationship.

2. **Analyze Math Relationships** How do you know if a relationship between two quantities is NOT proportional?

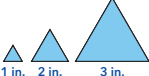
The ratios $\frac{y}{x}$ for all pairs of x and y will not be equivalent.

3. **Evaluate Reasonableness** If the ratio $\frac{y}{x}$ is the same for all related pairs of x and y , what does that mean about the relationship between x and y ?

It means that x and y have a proportional relationship.

4. **Analyze Math Relationships** Each triangle is equilateral. Is the relationship between the perimeter and the side length of all equilateral triangles proportional? Explain.

Yes; the quantities are proportional because the ratios $\frac{3}{1}$, $\frac{6}{2}$, and $\frac{9}{3}$ are equivalent.



Key Concept

If a set of numbers is multiplied or divided by a constant factor, the comparison of the original set of numbers to the resulting set of numbers is a set of equivalent ratios.

For example, multiplying each element of {1, 3, 5} by 2 gives {4, 12, 20} and $\frac{1}{4} = \frac{3}{12} = \frac{5}{20}$. A set of equivalent ratios represents a proportional relationship.

Talk About Math Ideas

How does a picture on a phone camera show proportionality? What is another example of a proportional relationship in your world?

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Connect INDIVIDUAL WHOLE CLASS

Connect Solution Strategies Use your students’ work or the sample student work to facilitate responses phrased in students’ own words. Encourage students to use the vocabulary *equivalent ratios*, *proportion*, and *proportional relationship*.

Item 1 Comparing and contrasting different solutions builds understanding of problems that involve proportional relationships. Have students focus on their use of equivalent ratios.

Item 2 Compare equivalent ratios to unit rates. The unit rate defines the relationship between quantities. All ratios that relate the quantities in a proportional relationship can be simplified to the unit rate.

Item 3 Introduce the idea of the ratio $\frac{y}{x}$ as a constant. If two quantities do not have equivalent ratios, they will not be proportional.

Item 4 Discuss why this is true of all equilateral triangles, not just the three shown in the problem. *What about an equilateral triangle with a side length of 10 inches? x inches? Can you write an equation that models this relationship?*

Key Concept

- How can you use structure to help you decide whether two quantities have a proportional relationship? [If you calculate the ratio $\frac{y}{x}$ for each data pair and they are equivalent, then the two quantities have a proportional relationship.]
- When testing ratios to see if they are equivalent, why is order important? [Ratios must be created by pairs of numbers that are related to each other in the situation (e.g., corresponding sides in a shape) and those numbers must be used in the same order in the ratios.]

Talk About Math Ideas

Have students engage in a think-pair-share to discuss the response to the question about phone cameras and proportionality. Listen for discussions about proportionality maintaining the same multiplicative relationship, which maintains the shape of an object that has been enlarged or reduced, or relative values in two sets of data.

Step 3 Practice and Problem-Solving



15-20 min



Interactive Practice



Adaptive Practice

Name _____

Practice and Problem Solving



5. The amount of seed a landscaper uses and the area of lawn covered have a proportional relationship. Complete the table.

Lawn Seed

Seed (oz)	2	3	4
Area Covered (ft ²)	50	75	100
Area Covered Seed	$\frac{50}{2} = \frac{25}{1}$	$\frac{75}{3} = \frac{25}{1}$	$\frac{100}{4} = \frac{25}{1}$

6. **Communicate Math Ideas** Is the relationship between the number of slices of salami in a sandwich and the number of Calories in the sandwich proportional? Explain.

Calories in a Sandwich

Slices of Salami	Calories
1	66
2	96
3	126
4	156

No; the ratios of Calories to slices of salami are not all equivalent.

7. **Connect Math Ideas** A wholesale club sells eggs by the dozen. Does the table show a proportional relationship between the number of dozens of eggs and the cost? Explain.

Cost of Dozens of Eggs

Dozen	Cost (\$)
6	21
8	28
10	35
14	49

Yes; the ratios of cost to dozens of eggs for all related pairs are equivalent.

8. Does the table show a proportional relationship? If so, what is the value of y when x is 11?

x	4	5	6	10
y	64	125	216	1,000

No; the quantities x and y do not have a proportional relationship, so you cannot use equivalent ratios to find the value of y when x is 11.

9. Does the table show a proportional relationship? If so, what is the value of y when x is 10?

x	5	6	7	8
y	$1\frac{2}{3}$	2	$2\frac{1}{3}$	$2\frac{2}{3}$

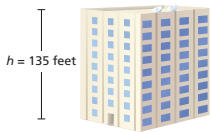
Yes; $y = 3\frac{1}{3}$

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Lesson 2-3 65

You may opt to have students complete automatically scored Practice and Problem Solving or Mixed Review online.

10. The height of a building is proportional to the number of floors. The figure shows the height of a building with 9 floors.



- a. **Evaluate Reasonableness** Write the ratio of height of the building to the number of floors. Then find the unit rate, and explain what it means in this situation.

$\frac{135 \text{ ft}}{9 \text{ floors}} = \frac{15 \text{ ft}}{1 \text{ floor}}$. Each floor of the building is 15 ft high.

- b. How tall would the building be if it had 15 floors?
225 ft

11. **Higher Order Thinking** Do the two tables show the same proportional relationship between x and y? Explain how you know.

Yes; All the ratios of y to x are equivalent. Every ratio $\frac{y}{x}$ is equivalent to $\frac{3}{4}$.

x	160	500	1,200
y	360	1,125	2,700

x	2	5	7
y	4.5	11.25	15.75

STAAR Assessment Practice

12. The table shows the number of cell phone towers a company will build as the number of its customers increases. 7.4D

PART A

Is the relationship between the number of towers and the number of customers proportional? Explain.

Yes; The ratios of towers to customers are all equivalent.

PART B

If there are 576 towers, how many customers does the company have? Create a proportion and solve.

12,000 customers

Cell Phone Towers

Customers (thousands)	Towers
5.25	252
6.25	300
7.25	348
9.25	444

13. Select all true statements about the table. 7.4D

- ☒ The table shows a proportional relationship.
☐ When x is 20, y is 2.55.
☐ All the ratios $\frac{y}{x}$ for related pairs of x and y are equivalent to 8.
☒ The unit rate of $\frac{y}{x}$ for related pairs of x and y is $\frac{1}{8}$.
☒ If the table continued, when x is 30, y would be 3.75.

x	12	18	22	26
y	1.5	2.25	2.75	3.25

66 Lesson 2-3

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Practice and Problem Solving

Engage Through Student Choice

Go online for an assignment strategy.

Error Intervention

Item 6 Students may see a pattern that shows that each slice of salami adds 30 Calories. Remind them that patterns can exist, but for the relationship to be proportional, the ratios of Calories to slices of salami have to be equivalent.

- What is the ratio of the number of Calories to the number of slices of salami in a sandwich with 1 slice? 2 slices? Are the ratios equivalent? [$\frac{66}{1}$, $\frac{96}{2} = \frac{48}{1}$; No]

Emergent Bilingual Student Support

Item 7

- What is unit rate in this problem? [The cost of 1 dozen eggs, or \$3.50]

65-66 Lesson 2-3

Item Analysis: Practice and Problem Solving

Item	DOK	TEKS	
		Content	Process
5, 8	1	7.4D	
6	1	7.4D	7.1D
7	1	7.4D	7.1F
10	1	7.4D	7.1B
9, 11-13	2	7.4D	

Quick Check



- Assess lesson content with the Quick Check.
- The online Quick Check is **automatically scored** and **remediation, practice, or enrichment** will be assigned based on student performance.
 - You can use the Assessment Sourcebook version to prescribe targeted remediation or enrichment.

Item	DOK	TEKS	
		Content	Process
1, 2, 4	1	7.4D*	7.1B, 7.1E
3, 5	2	7.4D*	7.1A, 7.1F

0-3 points: Reteach to Build Understanding and Additional Vocabulary Support Activities

4-5 points: Enrichment Activity

In addition, **emergent bilingual students** may benefit from the Build Mathematical Literacy Activity.

Differentiation Library

- Additional Differentiation Library resources are described at the start of this topic.
- Differentiation resources that support diverse learning styles are online and in the Differentiation Library Teacher’s Guide.

Video Tutorials Available on Savvas Realize®

Students can access these tutorials anytime to reinforce lesson content.

- Determine Whether Values in a Table are Proportional
- How Do You Know if Two Ratios are Proportional?

Item Analysis: Additional Practice

Item	DOK	TEKS	
		Content	Process
1	1	7.4D	
2, 3	1	7.4D	7.1G
4-9	2	7.4D	

Additional Practice

Printable or autoscored on Savvas Realize®

Name

2-3 Additional Practice

1. At a café, the cook uses a recipe that calls for eggs and milk. The amounts of eggs and milk have a proportional relationship. Complete the table.

Ingredients in Recipe			
Number of Eggs	2	3	4
Cups of Milk	6	9	12
Milk Eggs	$\frac{3}{1}$	$\frac{3}{1}$	$\frac{3}{1}$

2. Explain Math Ideas

Is the relationship between x and y proportional? Explain.

x	y
5	25
6	30
7	35
8	40

Yes; Sample answer: All the ratios of y to x are equivalent. Every ratio $\frac{y}{x}$ is equivalent to 5.

3. Justify Math Arguments

Does the table show a proportional relationship between x and y ? Explain.

x	y
2	4
4	16
7	79
10	100

No; Sample answer: All the ratios $\frac{y}{x}$ are not equivalent.

4. Does the table show a proportional relationship? If so, what is the value of y when x is $\frac{3}{5}$?

x	y
30	150
$\frac{1}{6}$	$\frac{5}{6}$
199	995
$\frac{2}{15}$	$\frac{2}{3}$

Yes; $y = 3$

5. In a stationery design, the number of ovals is proportional to the number of squares. How many squares will there be when there are 75 ovals?

15 squares

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6. The table shows a proportional relationship between x and y .

a. Complete the table.

x	y	$\frac{y}{x}$
3	30	$\frac{30}{3} = \frac{10}{1}$
5	50	$\frac{50}{5} = \frac{10}{1}$
7	70	$\frac{70}{7} = \frac{10}{1}$

b. Katerina says the ratio $\frac{y}{x}$ is $\frac{1}{10}$. What error did she likely make?

She found $\frac{y}{x}$ instead of $\frac{x}{y}$.

7. Higher Order Thinking

Do the two tables show the same proportional relationship between x and y ? Explain.

x	500	750	1,000
y	1,250	1,875	2,500

x	3	4	5
y	4.2	5.6	7

No; Sample answer: The first table shows $\frac{y}{x} = 2.5$. The second table shows $\frac{y}{x} = 1.4$. $2.5 \neq 1.4$.

STAAR Assessment Practice

8. During snowstorms, the city sends out trucks to plow. The amount of snowfall and the number of trucks sent out are shown in the table.

PART A

Is the relationship between the amount of snowfall and the number of trucks proportional? Explain.

Yes; the ratios of trucks to inches of snowfall are all equivalent to 2.5.

Snow Plowing Plan	
Snowfall (in.)	Trucks
6	15
8	20
12	30
18	45

PART B

For a 23-inch snowfall, how many trucks would the city send out? Explain.

Sample answer: For a 23-inch snowfall, the number of trucks would be 57.5. The city should send out 58 trucks to keep the roads safe.

9. Which of the following statements about the table is true? Select all true statements about the table.

☒ The table shows a proportional relationship.

☐ All the ratios $\frac{y}{x}$ for related pairs of x and y are equivalent to 7.5.

☒ When x is 13.5, y is 4.5.

☐ When y is 12, x is 4.

☒ The unit rate of $\frac{y}{x}$ for related pairs of x and y is $\frac{1}{3}$.

x	y
10.5	3.5
15.9	5.3
22.5	7.5
27	9

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Mixin' It Up

KEY CONCEPTS

Mathematics Objectives

- Use mathematical modeling to represent a problem situation and to propose a solution.
- Test and verify the appropriateness of math models.
- Explain why the results from mathematical models may not align exactly to the problem situation.

Language Objective Describe, orally and in writing, how to apply a mathematical model to solve a problem involving proportional relationships.

Essential Understanding Many real-world problem situations can be represented with a mathematical model, but that model may not represent a real-world situation exactly.

COHERENCE

Earlier in this topic, students:

- used equivalent ratios to understand and describe proportional relationships.

In this lesson, students:

- develop a mathematical model to represent and propose a solution to a problem situation involving proportions.

Later in this course, students will:

- refine their mathematical modeling skills.

BALANCE

Conceptual Understanding Students draw on their understanding of ratio and proportionality concepts to develop a representative model.

Application Students apply their mathematical model to test and validate its applicability to similar problem situations.

Reinforce Vocabulary

- model

Materials

Provide manipulatives and other tools that students request.

**Student Resources**

Family Engagement

Teacher Resources

Available on
Savvas Realize®

Editable Lesson Plan

enVision on the Go: Planning Support

**Texas Essential Knowledge and Skills (TEKS)****Mathematical Process Standards**

The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

7.1B Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.

7.1C Select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems.

7.1D Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.

7.1E Create and use representations to organize, record, and communicate mathematical ideas.

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The student applies mathematical process standards to represent and solve problems involving proportional relationships. The student is expected to:

7.4D* Solve problems involving ratios, rates, and percents, including multi-step problems involving percent increase and percent decrease, and financial literacy problems.

Also **7.7A***

*Readiness Standard

Act 1 The Hook



10-15 min

Act 1

Mixin' It Up

I can ... use mathematical modeling to solve problems.

TEKS 7.4D Solve problems involving ratios, rates, and percents, including multi-step problems involving percent increase and percent decrease, and financial literacy problems; Also 7.7A Mathematical Process Standards 7.1B, 7.1C, 7.1D, 7.1E

Let's Model in 3 Acts

Lesson 2-9

ACT 1



ACT 1

- After watching the video, what is the first question that comes to mind?
- Write the Main Question you will answer.
- Communicate Math Ideas** Predict an answer to this Main Question. Explain your prediction.
- On the number line below, write a number that is too small to be the answer. Write a number that is too large.
Too small Too large

- Plot your prediction on the same number line.

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Students are tasked with making the liquid in a water glass and in a large water cooler have the same flavor.

Play the Video

Take advantage of your students' reactions to watching the video. Ask: *What did you notice? What do you wonder?*

Brainstorm Questions WHOLE CLASS

Have students complete **Question 1**. Encourage them to ask any question that comes to mind. Listen for both mathematical and non-mathematical questions. Ask students what makes each question interesting.

- *What questions do you have?* [Sample questions: Who is going to drink all of that water? How much water is in the cooler? What is being added to the water? Why is it being added?]

Pose the Main Question WHOLE CLASS

After the question brainstorming, pose the Main Question students will be tasked with answering. Have students complete **Question 2**.

Main Question

- **How many drops are needed for the water in the cooler to have the same flavor as the water in the glass?**

Ask About Predictions WHOLE CLASS

Have students complete **Questions 3-5**. Survey the class about their predictions.

- *Why do you think your prediction is the solution to the Main Question?*
- *Who had predictions that are close?*
- *How many of you agree with that prediction?*
- *Who has a different prediction?*

Act 2 The Model



20-30 min

Act 2

ACT 2

6. What information in this situation would be helpful to know? How would you use that information?

7. **Select Tools** What tools can you use to solve the problem? Explain how you would use them strategically.

Build G.R.I.T. Time Management
To better manage your time effectively, you can choose tools that help you work efficiently.

8. **Use a Problem-Solving Model** Represent the situation using mathematics. Use your representation to answer the Main Question.



9. What is your answer to the Main Question? Is it higher or lower than your prediction? Explain why.

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Sample Student Work

1 gallon = 128 fl oz, so 10 gallons = 1,280 fl oz

$$\frac{5 \text{ drops}}{12 \text{ oz}} = \frac{d \text{ drops}}{1,280 \text{ fl oz}}$$
$$\frac{5}{12} \times 1,280 = \frac{d}{1,280} \times 1,280$$
$$533 \approx d$$

The water cooler needs 533 drops.

Marco's Work

Marco uses equivalent ratios to write and solve a proportion.

Vicki's Work

Vicki uses the constant of proportionality to write and solve a different form of the same proportion.

unit rate: $\frac{12 \text{ fl oz}}{5 \text{ drops}} = 2.4 \text{ fl oz per drop}$

$$w = 2.4d$$

w is water in fluid ounces; d is number of drops

10 gallons is 10×128 fluid ounces

$$(10 \times 128) = 2.4d$$
$$533 \approx d$$

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Identify Important Information WHOLE CLASS

Have students complete **Question 6**.

- What information do you need to know to solve the problem? [how much water is in the glass; how many drops are in the glass; how much water is in the water cooler]
- How could you get that information?
- Why do you need that information?

Reveal the Information WHOLE CLASS

As students identify needed information, you can use the online interactivity to estimate, reveal, and share the information.

Amount of water in the glass: 12 fluid ounces
Number of drops added to glass: 5
Size of water cooler: 10 gallons
1 gallon = 128 fluid ounces

Develop a Model SMALL GROUPS

For **Question 7**, students might select pencil and paper, concrete models, a ruler, a calculator, a spreadsheet, digital software, or other grade-appropriate tools to solve the problem.

As students answer **Questions 8 and 9**, look for inefficient methods that they are using and prompt them to think about organizing the information before making a model.

For example, a student may create the following table:

Amount of Water	Number of Drops
12 fl oz	5
24 fl oz	10
36 fl oz	15
48 fl oz	20

- How can you show the relationship between the amount of water and the number of drops more efficiently? [Use a ratio.]

Share Solution Strategies WHOLE CLASS

After students answer **Questions 8 and 9**, use the Sample Student Work as you facilitate a discussion about solution methods.

Act 3

ACT 3

10. Write the answer you saw in the video.

11. **Evaluating Reasonableness** Does your answer match the answer in the video? If not, what are some reasons that would explain the difference?

12. **Select Techniques** Would you change your model now that you know the answer? Explain.



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Reflect

13. **Represent Math Ideas** Explain how you used a mathematical model to represent the situation. How did the model help you answer the Main Question?

14. **Communicate Reasoning** Choose a classmate's model. How would you adjust that model?

Create a Problem

15. Write your own problem related to the video in Act 1. Include any information needed to solve your problem. Explain how you would use a mathematical model to represent your situation. Then solve your problem.

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Use the Video to Reveal the Answer

WHOLE CLASS

The final part of the video shows the process of adding flavoring to the water cooler. Have students complete **Question 10**.

Main Question Answer

518 drops

Validate Conclusions SMALL GROUPS

After **Questions 11 and 12**, discuss possible sources of error inherent in using math to model real-world situations. Point out that the models are still useful even though they are not perfect.

- Why does your answer not match the answer in the video? [The video shows that the water cooler is not completely full.]
- How useful was your model at predicting the answer?
- How could your model better represent the situation?

Reflect on Thinking SMALL GROUPS

Have students complete **Questions 13 and 14** as an extension. Discuss how students applied mathematical processes. How might you analyze and evaluate the efficiency of the approach you chose to solve the problem?

Create a Problem INDIVIDUAL

Use **Question 15** as an opportunity for students to revisit other questions they had during **Question 1** brainstorming.

Possible Student Solution

A classmate usually adds 6 drops to 16 ounces of water. How many drops would she use for the water cooler?

Amount of Water	Number of Drops
16 fl oz	6
32 fl oz	12
64 fl oz	24
128 fl oz	48
1,280 fl oz	480

The classmate would use 480 drops.