UNITED ARAB EMIRATES
MINISTRY OF EDUCATION

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TEACHER EDITION

MATH
2018 - 2019

6

McGraw-Hill Education

Advanced Science Program: Math

United Arab Emirates Edition

Mc Graw Hill Education

Focus narrowing the scope

This chapter focuses on content from the **Ratios and Proportional Relationships** domain.

Coherence connecting within and across grades

Previous
Students wrote equivalent fractions.

Now
Students use ratio tables, bar diagrams, and reasoning to solve ratio and rate problems.

Next
Students will apply the concept of rate to problems involving linear functions.

Rigor pursuing concepts, fluency, and applications

The Levels of Complexity charts located throughout this chapter indicate how the exercises progress from concept understanding and procedural skills and fluency, to applic and critical thinking.

Launch the Chapter

Math in the Real World

Cheetahs Have students create different bar diagrams to f how far the cheetah will run after different amounts of tim Then have them find the top speed of another animal and compare the distance that animal can run at top speed to distance the cheetah can run.

Throughout this text, refer to the following icons to find differentiated strategies to meet the needs of all learners.

- AL Approaching-Level Learners
- OL On-Level Learners
- BL Beyond-Level Learners
- LA Language Acquisition

What Tools Do You Need?

Vocabulary Activity

LA As you proceed through the chapter, introduce each vocabulary term using the following routine. Ask the students to say each term aloud after you say it.

Define: An equivalent ratio is two ratios that express the same relationship between two quantities.

Example: 2:6 is equivalent to 20:10

Ask:

- *What is an equivalent ratio to 30:18?* Sample answers: 6:54, 5:45, 12:108

Studying Math

LA Have students read the New Vocabulary section and review the questions and the word map.

Ask:

- *Why should you relate new words to information you already know rather than memorizing the definition?* Sample answer: Relating new words to information I already know helps me to understand important concepts and word problems.
- *What are the parts of the word map?* Sample answer: the vocabulary word, the definition of the word from the text, the definition in my own words, examples, and nonexamples
- *In the graphic organizer, into which box is the vocabulary word placed?* the center box

What Tools Do You Need?

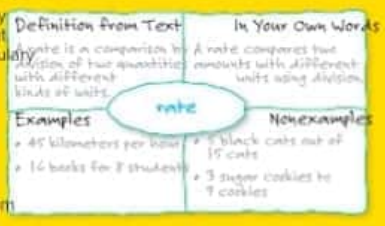
Vocabulary

coordinate plane	origin	unit price
equivalent ratio	prime factorization	unit rate
graph	rate	*x*-axis
greatest common factor	ratio	*x*-coordinate
least common multiple	ratio table	*y*-axis
ordered pair	scaling	*y*-coordinate

Study Skill: Studying Math

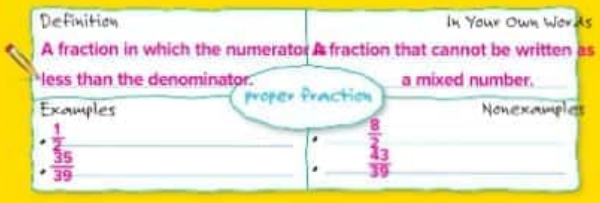
New Vocabulary New vocabulary terms are clues about important concepts. Learning new vocabulary words is more than just memorizing the definition. Whenever you see a new vocabulary word, ask yourself:

- How does this fit with what I already know?
- How is this alike or different from something I learned earlier?



Organize your answers in a word map like the one shown.

Make a word map for *proper fraction*. Sample answers are given.



What Dodu Already Know?

Place a checkmark below the face that expresses how much you know about each concept. Then scan the chapter to find a definition or example of each. See students' work.

I have no clue. I've heard of it. I know it!

Concept				Definition or Example
greatest common factor				
ordered pairs				
prime factorization				
ratios				
the coordinate plane				
unit rates				

When Will You Use This?

Here is an example of how unit rates are used in the real world.

Activity Use a newspaper to find an ad for two different grocery stores. See if you can find an offer for the same item. How do the prices compare? Which one do you think is offering a better deal? Explain your reasoning.

See students' work.

What Dodu Already Know?

In this activity, students assess their prior knowledge choo a face to represent their knowledge about concepts in the chapter.

After completing the chapter, have students return to this p and have them re-evaluate their knowledge level about th content.

When Will You Use This?

Activity

Students should understand that when they are comparin prices of items in the store, they are really comparing rate

Are You Ready?

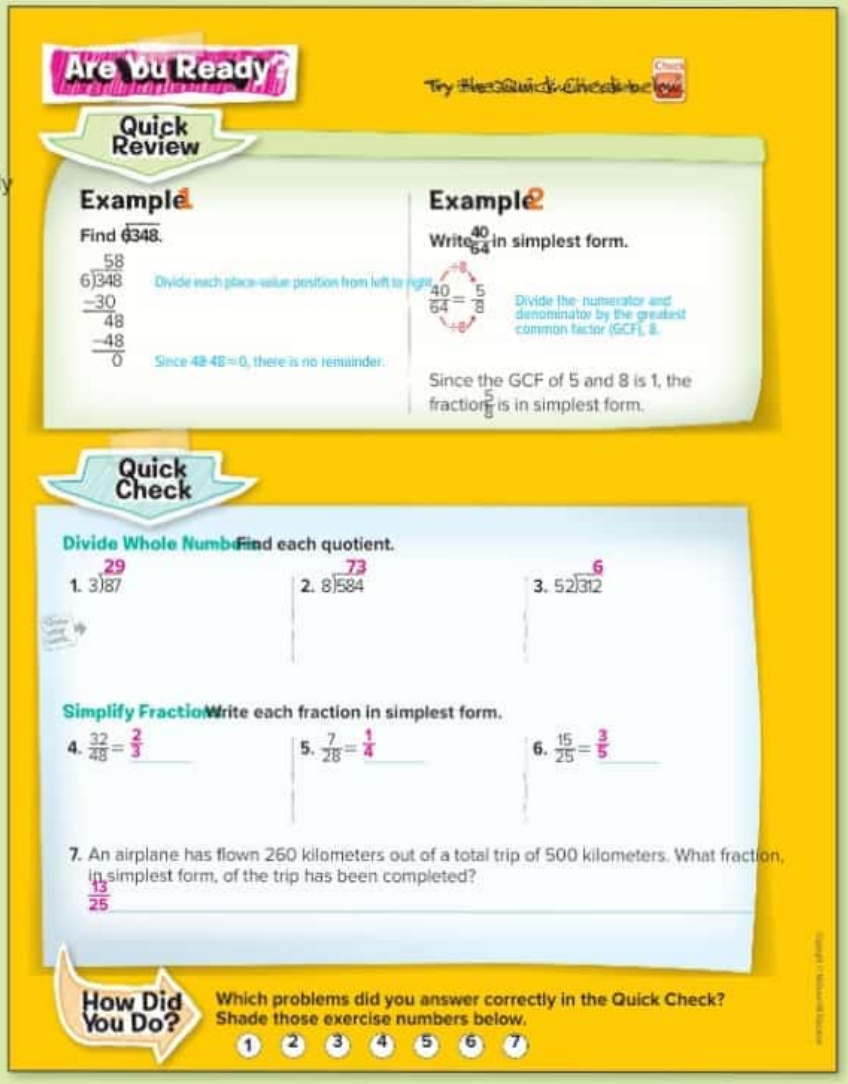
Use this page to determine if students have skills that are needed for the chapter.

Quick Review
Students with strong math backgrounds may opt to go directly to the Quick Check.

Quick Check
If students have difficulty with the exercises, present an additional example to clarify any misconceptions.

Exercises 1–3
Find $5\overline{)245}$. 49

Exercises 4–7
Write $\frac{18}{45}$ in simplest form. $\frac{2}{5}$



Lesson 1

Factors and Multiples

Vocabulary Start-Up

A *common factor* is a number that is a factor of two or more numbers. The greatest of the common factors of two or more numbers is called the **greatest common factor** (GCF).

The least nonzero number that is a multiple of two or more whole numbers is the **least common multiple** (LCM) of the numbers.

Fill in the charts below. Sample answers are given.

GCF	LCM
• stands for: Greatest Common Factor	• stands for: Least Common Multiple
Define:	Define:
• Greatest: The largest of a set of values.	• least: The smallest of a set of values.
• Common: The same feature among several numbers.	• Common: The same feature among several numbers.
• Factor: A number that is multiplied by another number.	• Multiple: The product of a number and any whole number.

Essential Question

HOW do you use equivalent rates in the real world?

Vocabulary

greatest common factor
least common multiple

Mathematical Practices

1, 3, 4, 8

Real-World Link

Adil is making balloon arrangements. He has 8 blue and 12 green balloons. What is the greatest number of arrangements he can make if he wants them to be identical?

4 arrangements

Which **Mathematical Practices** do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Find the GCF and LCM.

Coherence connecting within and across grades

Previous	Now	Next
Students identified common factors of a set of numbers.	Students find the greatest common factor and least common multiple of a set of whole numbers.	Students will use counters to represent ratios.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 11.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA Pairs Discussion Have student work in pairs to complete the graphic organizers on GCF and LCM. Have them trade their graphic organizers with another pa students and discuss any differences. MP 3, 5

Alternate Strategy

AL If students are having difficulty, give them a chart of t numbers from 1–50. Have students circle the factors of 36 Using a different color, have them circle the factors of 48. them that the numbers they circled twice are the common factors of 36 and 48. MP 1, 5, 8

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Find the GCF.

AL • *What must we find to answer the question?* the GCF of 10, 15, and 20

OL • *What are the factors of 10?* 1, 2, 5, 10
• *What are the factors of 15?* 1, 3, 5, 15
• *What are the factors of 20?* 1, 2, 4, 5, 10, 20

BL • *What are the common factors?* 1 and 5
• *What is the greatest common factor?* 5
• *What is the greatest number of servings each row can have?* 5

Need Another Example?
Zayed has 60 carrot sticks and 42 celery sticks. He wants to package them in plastic bags so that each bag has an equal number of carrot sticks and an equal number of celery sticks. What is the greatest number of bags he can put together? 6

2. Find the GCF using prime factors.

AL • *How would you find the prime factorization of 12 and 18?* make a factor tree

OL • *What are two factors of 12?* Sample answer: 6 and 2
• *What are two factors of 18?* Sample answer: 9 and 2
• *Are these numbers prime? If not, what do we need to do next?* 2 is prime, but 6 and 9 are composite; We have to continue the factor tree by finding the prime factors of 6 and 9.

BL • *After completing the factor tree, what are the common factors?* 2 and 3

Need Another Example?
Find the greatest common factor of 20, 32, and 36.

Work Zone

Prime Numbers
Remember that a prime number is a whole number that has exactly two factors, 1 and the number itself.

a. AED 7

b. 6

c. 6

d. 16

Find the Greatest Common Factor

You can use common factors or prime factors to find the GCF.

Example

1. There are one-slice servings of three types of cake on a table. Each row has an equal number of servings and only one type of cake. What is the greatest number of servings in each row?

Cakes	
Type	Number of Servings
marble	10
red velvet	15
chocolate	20

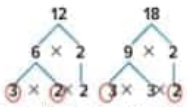
To solve this problem, use common factors.
factors of 10: 1, 2, 5, 10
factors of 15: 1, 3, 5, 15
factors of 20: 1, 2, 4, 5, 10, 20 The common factors are 1 and 5.
The GCF of 10, 15, and 20 is 5. So, the greatest number of pieces of cake that can be placed in each row is 5.

Get It? Do these problems to find out.

a. Lana earned AED 49 on Friday, AED 42 on Saturday, and AED 21 on Sunday selling bracelets. She sold each bracelet for the same amount. What is the most she could have charged for each bracelet?

Example

2. Find the GCF of 12 and 18.



2 and 3 are the common prime factors.

So, the GCF of 12 and 18 is 2 or 6.

Get It? Do these problems to find out.

Find the greatest common factor of each set of numbers.

b. 12, 66 **c.** 18, 30 **d.** 32, 48

Find the Least Common Multiple

You can find the least common multiple (LCM) by using a number line, making a list, or by using prime factors.

Examples

3. Find the LCM of 2 and 3.

Method 1 Use a number line.

Put a red X above each nonzero multiple of 2 and a blue X above each nonzero multiple of 3.

The least number with both a red and a blue X is 6.

So, 6 is the least common multiple of 2 and 3.

Method 2 Use an organized list.

List the nonzero multiples of 2 and 3.

multiples of 2: 2, 4, 6, 8, 10, 12, ... 1×2, 2×2, 3×2, ...

multiples of 3: 3, 6, 9, 12, 15, ... 1×3, 2×3, 3×3, ...

Notice that 6 and 12 are common multiples.

So, the least common multiple of 2 and 3 is 6.

4. Find the LCM of 14 and 21 using prime factorization.

Write the prime factorization of each number.

7 is the only common prime factor.

Multiply using each common prime factor only once.

So, the LCM is 7 × 3 or 42.

Got it? Do these problems to find out.

Find the least common multiple of each set of numbers.

e. 2, 6 **f.** 4, 5, 10 **g.** 3, 5, 7

Multiples

e. 6

f. 20

g. 105

Examples

3. Find the LCM using a number line or list.

AL • *How can we mark the multiples of 2 on the number line?* Sample answer: use a red X

• *How can we mark the multiples of 3 on the number line?* Sample answer: use a blue X

OL • *How far to the right on the number line should we mark the multiples?* Sample answer: We should mark four to five multiples of 2, then mark the multiples of 3. If there are no numbers on the number line with both a red and a blue X, then we need to mark more multiples for both 2 and 3

BL • *Why do we not need to mark any more multiples of 2 and 3?* Sample answer: we are trying to find the least number that 2 and 3 have in common. Once we find the place on the number line with both a red and blue X, we do not need to continue any farther

Need Another Example?
Find the LCM of 9 and 12. 36

4. Find the LCM using prime factorization.

AL • *What are two factors of 14 and 21?* 7 and 3

OL • *Are there other factors we could have chosen?* No. Those are the only factors of 14 and 21.

• *What is the common factor?* 7

• *Why do we multiply by 7 only once?* 7 is a common factor, so we only multiply by it once.

BL • *Why can we not just multiply 14 by 21 to find a multi* Multiplying 14 by 21 will give us a multiple of both numb but not the least multiple that they have in common.

Need Another Example?
Find the LCM of 4, 6, and 8. 24

Example

5. Use the LCM.

AL • *What do we have to find in order to answer the question?* the LCM of 2 and 5

OL • *What are the methods we can use to find the LCM?* use a number line, use an organized list, or use a factor tree

• *What are some multiples of 2?* Sample answer: 2, 4, 6, 8, 10, 12, 14, . . .

• *What are some multiples of 5?* Sample answer: 5, 10, 15, 20, 25, 30, . . .

• *What is the least common multiple?* 10

BL • *Is there a quicker way to find the LCM of 2 and 5? Explain.* yes; Because 2 and 5 are both prime, we can multiply them together to find the LCM

Need Another Example?

At the grand opening of a store, every sixth customer to enter the store is given a AED 10 gift certificate and every ninth customer is given a coupon for 10% off their total purchase. Which customer is the first to receive both gifts? customer 18

Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Think-Pair-Share** Have students work in pairs. Give students one minute to think through their responses to Exercises 1–3. Have them share their responses with their partner. Then call on one student to share their responses within a small group or large group discussion. Repeat with Exercises 4–MP 1, 3

BL LA **Trade-a-Problem** Each student creates a problem to be solved similar to Exercise 7. Student trade their problems, solve each other's problem, and compare solutions. If the solutions do not agree, students work together to find the errors. MP 1, 3, 4

Example

5. Zaid has painting class every 2 weeks. Kaif has a pottery class every 5 weeks. Zaid and Kaif met at the art building for class this week. How many weeks will it be until they see each other again?

multiples of 2: 2, 4, 6, 8, 10, 12, 14,...

multiples of 5: 5, 10, 15, 20, 25, 30,...

The least common multiple of 2 and 5 is 10. So, Zaid and Kaif will see each other again in 10 weeks.

Guided Practice

Find the greatest common factor of each set of numbers.

1. 8, 32 — 8
2. 24, 60 — 12
3. 3, 12, 18 — 3

Find the least common multiple of each set of numbers.

4. 7, 9 — 63
5. 6, 15 — 30
6. 9, 12, 15 — 180

7. The Movie House gives away a AED 5 coupon for every 4 movies purchased. They give away a bag of popcorn for every 3 movies purchased. How many movies would you have to purchase in all before receiving both a AED 5 coupon and a bag of popcorn at the same purchase? 12 movies

8. **Building on the Essential Question** How does finding the greatest common factor help you to solve real-world problems? Sample answer: The greatest common factor can help you to divide a number of different items equally among a group of people.

Rate Yourself!

Are you ready to move on? Shade the section that applies.

Name _____ My Homework _____

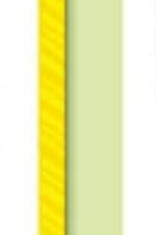
Independent Practice

Find the greatest common factor of each set of numbers.

1. 8, 14 2
2. 21, 24, 27 3
3. 21, 35, 49 7
4. 12, 18, 26 2

Find the least common multiple of each set of numbers.

5. 5 and 6 30
6. 6 and 9 18
7. 6, 12, and 15 60
8. 3, 9, and 15 45



9. A gardener has 27 pansies and 36 daisies. He plants an equal number of each type of flower in each row. What is the greatest possible number of pansies in each row? Example 3

9 pansies

10. Fourteen boys and 21 girls will be equally divided into groups. Find the greatest number of groups that can be created if no one is left out.

7 groups

ENGAGE EXPLORE **EXPLAIN** **ELABORATE** **EVALUATE**

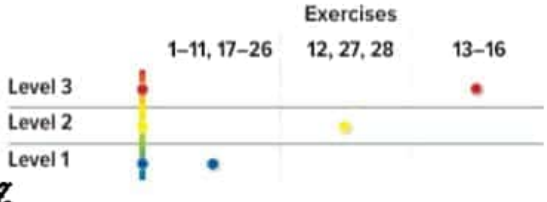
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–11, 13, 14, 16, 27, 28
OL	On Level	1–11 odd, 12–14, 16, 27, 28
BL	Beyond Level	12–16, 27, 28

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	15
3 Construct viable arguments and critique the reasoning of others.	16
4 Model with mathematics.	13
8 Look for and express regularity in repeated reasoning.	12, 14, 26

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET
Out the Door

Ask students to find the least common multiple of 10, 12, and 15.60

11. Noor waters her plants every two days. She trims them every 15 days. She did both today. When will she do both again? **30 days**

12. **Identify Repeated Reasoning** airport offers two shuttles that run on different schedules. If both shuttles leave the airport at 4:00 P.M., at what time will they next leave the airport together?
4:18 P.M.

Shuttle Schedule	
Shuttle	Departs
A	every 6 minutes
B	every 9 minutes

H.O.T. Problems Higher Order Thinking

13. **Model with Mathematics** Write and solve a real-world problem that can be solved using the greatest common factor of two numbers.
Sample answer: A gardener has 27 daisies and 36 marigolds. An equal number of each flower is planted in each row. What is the greatest number of marigolds in each row? 9 marigolds

14. **Identify Repeated Reasoning** How can you use number patterns to find the least common multiple of 120 and 360?
Sample answer: You can divide both numbers by 10 and think about the LCM of 12 and 36. Since 36 is the LCM of 12 and 36, 360 is the LCM of 120 and 360.

15. **Persevere with Problems** If the GCF of two numbers is 1, they are called *relatively prime*. Find three sets of relatively prime numbers.
7 and 20, 5 and 8, 4 and 9

16. **Use a Counterexample** Determine whether each statement is *true* or *false*. If *true*, explain why. If *false*, give a counterexample.

a. The GCF of any two even numbers is always even.
true; Sample answer: All even numbers have a factor of 2. So, the GCF will always have 2 as a factor. So the GCF of two even number is always even.

b. The GCF of any two odd numbers is always odd.
true; Sample answer: An odd number does not have a factor of 2. So, the GCF of two odd numbers will not have a factor of 2 and is always odd.

c. The GCF of an odd number and an even number is always even.
false; Sample answer: The GCF of 45 and 60 is 15.

Name _____ My Homework _____

Extra Practice

Find the greatest common factor of each set of numbers.

17. 15, 20 5

factors of 15: 1, 3, 5, 15
factors of 20: 1, 2, 4, 5, 10, 20
The common factors are 1 and 5.
The GCF is 5.

18. 30, 48, 60 6

19. 24, 30, 42 6

20. 24, 40, 56 8

Find the least common multiple of each set of numbers.

21. 3 and 5 15

multiples of 3: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
multiples of 5: 5, 10, 15, 20, 25, 30
The common multiples are 15 and 30.
The LCM is 15.

22. 12 and 18 36

23. 5, 10, and 15 30

24. 9, 12, and 18 36

25. A grocery store clerk has 16 oranges, 20 apples, and 24 pears. The clerk needs to put an equal number of apples, oranges, and pears into each basket. What is the greatest number of baskets that can be made so that no fruit is left?

4 baskets

26. **Identify Repeated Reasoning** A science department buys the equipment shown in the table. They bought all three items this year. In how many years will they have to buy all three items again?

Item	Time Bought
Microscopes	every 5 years
Safety goggles	every 4 years
Test tubes	every 2 years

20 years

Power Up! Test Practice

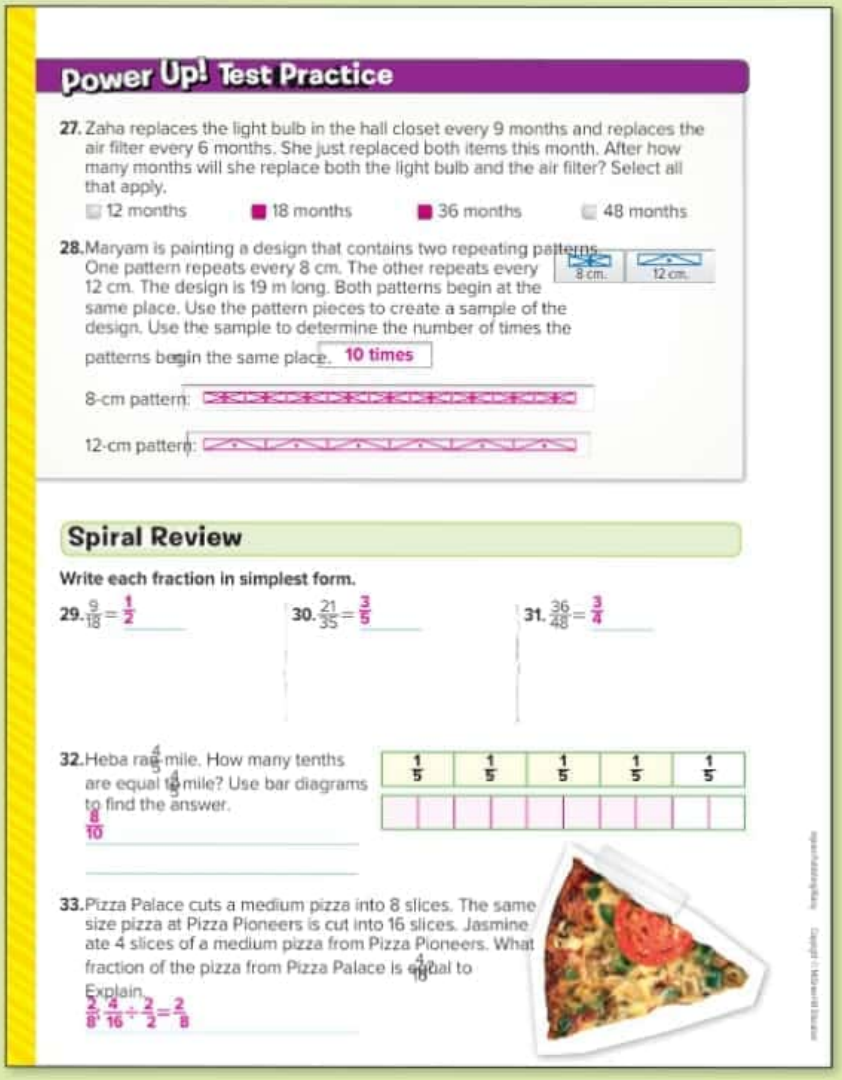
Exercises 27 and 28 prepare students for more rigorous thinking needed.

27. This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.

Depth of Knowledge	DOK1
Mathematical Practice	MP4
Scoring Rubric	
1 point	Both 18 months and 36 months must be selected to receive credit.

28. This test item requires students to analyze and solve complex real-world problems through the use of mathematical tools and models.

Depth of Knowledge	DOK3
Mathematical Practices	MP1, MP4, MP5
Scoring Rubric	
2 points	Student must correctly draw the patterns for 1 point AND 10 must be written in the answer box.
1 point	Student correctly draws the pattern OR writes 10 in the answer box.



Power Up! Test Practice

27. Zaha replaces the light bulb in the hall closet every 9 months and replaces the air filter every 6 months. She just replaced both items this month. After how many months will she replace both the light bulb and the air filter? Select all that apply.

☐ 12 months ■ 18 months ■ 36 months ☐ 48 months

28. Maryam is painting a design that contains two repeating patterns. One pattern repeats every 8 cm. The other repeats every 12 cm. The design is 19 m long. Both patterns begin at the same place. Use the pattern pieces to create a sample of the design. Use the sample to determine the number of times the patterns begin the same place. **10 times**

8 cm 12 cm

8-cm pattern:

12-cm pattern:

Spiral Review

Write each fraction in simplest form.

29. $\frac{9}{18} = \frac{1}{2}$

30. $\frac{21}{35} = \frac{3}{5}$

31. $\frac{36}{48} = \frac{3}{4}$

32. Heba ran $\frac{4}{5}$ mile. How many tenths are equal to $\frac{4}{5}$ mile? Use bar diagrams to find the answer. $\frac{8}{10}$

$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$

33. Pizza Palace cuts a medium pizza into 8 slices. The same size pizza at Pizza Pioneers is cut into 16 slices. Jasmine ate 4 slices of a medium pizza from Pizza Pioneers. What fraction of the pizza from Pizza Palace is equal to $\frac{4}{16}$? Explain. $\frac{2}{8}$; $\frac{4}{16} \div \frac{2}{2} = \frac{2}{8}$

Inquiry Lab
Ratios

Inquiry **HOW can you use tables to relate quantities?**

Mathematical Practices 1, 3, 4

Ali has 3 fiction books and 6 nonfiction books to donate to the community center. He wants to package them so that there are an equal number of fiction and nonfiction books in each group. He also wants to have as many packages as possible. How many books are in each group?

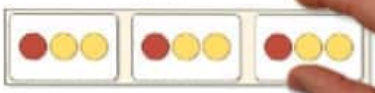
What do you know? Ali has 3 fiction books and 6 nonfiction books. Ali wants as many equal packages of books as possible.

What do you need to find? the number of books in each group

Hands-On Activity 1

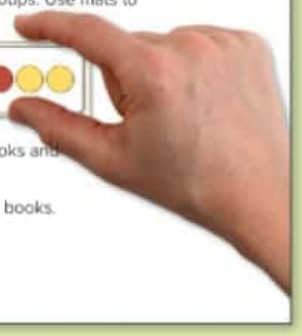
Step 1 Use 3 red counters to represent the fiction books. Use 6 yellow counters to represent the nonfiction books.

Step 2 Determine the smallest possible equal-size groups. Use mats to divide the counters into the groups.



Each group has an equal number of fiction books and an equal number of nonfiction books.

Each group has 1 fiction book and 2 nonfiction books.



Focus narrowing the scope

Objective Represent ratios using concrete models.

Coherence connecting within and across grades

Now Students use counters to represent ratios.

Next Students will give examples of ratios as fractions.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 17.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lab

Activities 1–3 are intended to be used as whole-group activities. Activity 1 is designed to provide more guidance to students than Activities 2 and 3.

Materials: counters

Hands-On Activity 1

AL LA **Paired Heads Together** Have students work with a partner to complete Steps 1 and 2. Have them respond to the following questions. MP 1, 3, 5

Ask:

- *How are the groups of counters in Step 1 and Step 2 sim*
  Sample answer: The total number of counters is the same. Th total number of red counters is the same and the total numbe yellow counters is the same.
- *How are the groups of counters in Step 1 and Step 2 different?* Sample answer: In Step 1, the comparison is 3 red t 6 yellow. In Step 2, the comparison in each group is 1 red to 2 yellow.

Hands-On Activity 2

Paired Heads Together Have students work with the same partner they worked with in Activity 1. Have them use repeated addition, or multiplication, to complete the table. Then have them respond to the following question.
MP 1, 3, 5

Ask:

- *How can you use multiplication to determine the number of nonfiction books needed if Maria already has 9 fiction books?* Sample answer: Since $\times 3 = 9$, I can multiply 4 by 3 to get 12 nonfiction books.

Trade-a-Problem Have students work with a partner to write an extension of the problem. For example, they may ask for the number of nonfiction books Maria needs if she has 27 fiction books. Have them trade problems with a partner. Each partner uses the multiplication table, or another method, to solve the problem. Then have them respond to the following exercis
MP 1, 3, 4, 5

Ask:

- *If Maryam had 48 nonfiction books, describe two different ways that you could use to determine the number of fiction books needed.* Sample answer: Extend the table for two more columns or use division and multiplication. Since $4 \times 12 = 48$, multiply 3 by 12 to get 36.

Hands-On Activity 3

Paired Heads Together Have students work with the same partner they worked with in Activities 1 and 2. Have them use 27 counters to model the problem by dividing the counters into groups of 4 and groups of 5.
MP

Ask:

- *Why do we need to find a sum in Step 2?* There are 27 jerseys altogether and the rows only indicate the red jerseys and the blue jerseys. We need to locate the column that has a sum (total) of 27 jerseys.

Hands-On Activity 2

Maryam is also collecting books. She wants to make packages that have 3 fiction books and 4 nonfiction books. She already has 9 fiction books. How many nonfiction books will she need?

Use a multiplication table to compare the numbers.

Step 1 Complete the rows for 3 and 4 on a multiplication table.

fiction →	3	6	9	12	15	18	21	24	27	30
nonfiction →	4	8	12	16	20	24	28	32	36	40

Step 2 Read across the top until you reach 9. Find the corresponding number in the bottom row and circle the 2 numbers.

Maryam needs 12 nonfiction books.

Hands-On Activity 3

Soliman has 27 jerseys. Divide them into two groups so that for every 4 red jerseys, there are 5 blue jerseys.

Step 1 Complete the rows for 4 and 5 on a multiplication table.

red →	4	8	12	16	20	24	28	32	36	40
blue →	5	10	15	20	25	30	35	40	45	50

Step 2 Read across both rows until you find two numbers with a sum of 27.

There are 12 red jerseys and 15 blue jerseys.

Check Draw a picture to check your answer. Sample answer is given.

Investigate

Work with a partner. Determine the number of pieces of fruit that should be put in each group. Make as many equal-size groups as possible using all the fruit. Use and draw counters to represent the fruit.

1. 3 apples and 9 pears

2. 4 peaches and 6 oranges

3. 4 plums and 7 bananas

4. 6 apricots and 9 mangos

Work with a partner. Use a multiplication table to solve the following problems.

5. Eiman wants groups of 3 notebooks and 5 pens. She already has 12 notebooks. How many pens will she need? **20 pens**

notebooks	3	6	9	12	15	18	21	24	27	30
pens	5	10	15	20	25	30	35	40	45	50

6. Hassan wants groups of 6 daisies and 8 tulips for flower arrangements. He already has 24 daisies. How many tulips will he need? **32 tulips**

daisies	6	12	18	24	30	36	42	48	54	60
tulips	8	16	24	32	40	48	56	64	72	80

7. Sheikha has 77 strawberries. Divide them into two groups so that for every 4 strawberries in Group 1 there are 7 strawberries in Group 2.

Group 1	4	8	12	16	20	24	28	32	36	40
Group 2	7	14	21	28	35	42	49	56	63	70

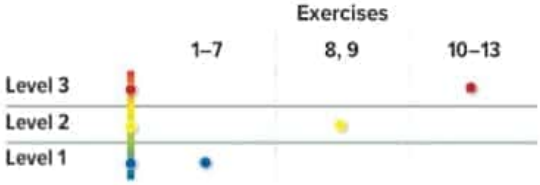
ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

2 Collaborate

The **Investigate** and **Analyze and Reflect** tions are intended to be used as small-group investigati **Create** e section is intended to be used as independent exercises.

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Investigate

AL LA **Rally Coach** Have students work with a partner to complete Exercises 1–4. Student 1 models the situation us counters, while talking through their process aloud, while Student 2 watches, listens, and coaches. Have students alternate being the "coach" for each exercise. Then have students complete Exercises 5–7 using a similar process. Student 1 completes the multiplication tabl while talking through their process alo while Stude s, list and coaches. Students alt e roles f exercise.

MP 1, 3, 5

BL LA **Pairs Discussion** Students work in pairs to devise a method for completing exercises without us counters or a multiplication table. Have students share the method with another pair of students and check the accu of each method and to determine which method they pre

MP 1, 3, 5, 6

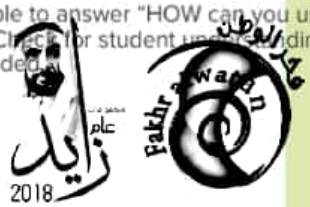
Analyze and Reflect

AL LA **Pairs Check** Have students work with a partner to complete Exercises 8 and 9. Student 1 thinks through their solution to Exercise 8 while Student 2 thinks through their solution to Exercise 9. Then each student presents their response to their exercise. Students ask any clarifying questions of each other, making sure that each student understands the other student's exercise and response. Then Student 2 records the answer for Exercise 8, while Student 1 records the answer for Exercise 9. Finally, have students read each other's answer and determine if they agree or disagree. Have them resolve any differences.
MP 1, 3

Create

AL LA **Gallery Walk** Have students draw models of counters or multiplication tables that would represent each of their problems in Exercises 10–12. Then have them post their models or tables around the room. Have students walk around the room and identify whether each model or table represents Exercise 10, 11, or 12. Have them justify their response.
MP 1, 3, 5

EQUITY Students should be able to answer "HOW can you use tables to relate quantities?" Check for student understanding and provide guidance, if needed.



Analyze and Reflect

Sample answers: 8–13

8. MP **Identify Repeated Reasoning** Describe the patterns used in the tables in Activities 2 and 3.
Each row of the tables shows the multiple of a certain number. You can add or subtract these multiples to find the number in one group or to find the total number in both groups.

9. MP **Reason Inductively** How would finding the least common multiple help you when dividing items into equal groups?
The least common multiple indicates that the groups can be equal and shows the number of items in each group.

Create

10. MP **Model with Mathematics** Write and solve a word problem in which there are 3 yellow beads for every 2 blue beads.
Sample answer: Suha has 30 yellow beads. She would like to make key chains that have 3 yellow beads for every 2 blue beads. How many blue beads does she need? 20 blue beads

11. MP **Model with Mathematics** Write and solve a real-world word problem in which there are 3 tables for every 8 chairs.
Sample answer: There will be 40 guests at the tennis club's banquet. Every 3 tables can seat 8 people. How many tables will they need? 15 tables

12. MP **Model with Mathematics** Write and solve a real-world word problem in which there are 3 pancakes for every person.
Sample answer: Mohsen is making breakfast for his family and has enough ingredients to make 15 pancakes. If each person will receive 3 pancakes, how many people are in his family? 5 people

13. EQUITY HOW can you use tables to relate quantities?
You can use tables to show the common multiples of two numbers. Tables can also help you compare groups of numbers.

Lesson 2

Ratios

Real-World Link

Horses In her exercising business, Mrs. Hessa walks 2 large Arabians and 8 smaller Mustangs.

Compare the number of smaller horses to the larger ones. Use yellow counters to represent the Arabians. Use red counters to represent the Mustangs. Draw the counters in the box.

1. $2 + \boxed{6} = 8$ There are 6 *more* Mustangs than Arabians.
2. $2 \times \boxed{4} = 8$ There are 4 *times* as many Mustangs as Arabians.
3. $8 - \boxed{6} = 2$ There are 6 *fewer* Arabians than Mustangs.
4. $8 \div \boxed{4} = 2$ The number of Arabians is $\frac{1}{4}$ the number of Mustangs.

Essential Question

HOW do you use equivalent ratios in the real world?

Vocab **Vocabulary**

None

Mathematical Practices

1, 3, 4, 5

Which **Mathematical Practices** do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Give examples of ratios as fractions and use ratio to compare quantities.

Coherence connecting within and across grades

Previous Students used models to represent ratios.

Now Students write ratios and use ratios to compare data.

Next Students will find and use unit rates.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 23.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Pairs Discussion** Have pairs of students complete Exercises 1–4 and discuss the similarities and differences of each compa MP 1, 5

Alternate Strategy

AL LA Discuss how the word *compare* has different meanings when used in different contexts. Ask them to th of situations where the term might represent a situation th uses the symbol > or <, and when the term might represent a situation in which one amount is twice as much as the o MP 1, 3, 6

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Example

1. Write a ratio in simplest form and explain its meaning.

AL
- *How many red paper clips are there? 2; 6*
- *If you divide the red paper clips and blue paper clips into equal groups, so that the same number of reds and same number of blues are in each group, how many reds will be in each group? 1 red; 3 blues*

OL
- *What ratio compares the total number of reds to blues? $\frac{2}{6}$; 2 to 6; 2:6*
- *Write the ratio in simplest form. $\frac{1}{3}$; 1 to 3; 1:3*

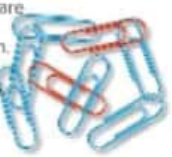
BL
- *Explain the meaning of this ratio.* For every red paper clip, there are 3 blue paper clips.

Need Another Example?
Write the ratio in simplest form that compares the number of baseballs to the number of soccer balls. Then explain its meaning. $\frac{2}{5}$; For every 2 baseballs, there are 5 soccer balls.

Work Zone

Write a Ratio in Simplest Form

There are many different ways to compare amounts or *quantities*. A **ratio** is a comparison of two quantities by division. A ratio of 2 red paper clips to 6 blue paper clips can be written in three ways.

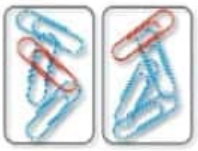


2 to 6 2:6 $\frac{2}{6}$

As with fractions, ratios are often expressed in simplest form.

Example

1. Write the ratio in simplest form that compares the number of red paper clips to the number of blue paper clips. Then explain its meaning.



Write the ratio as a fraction. Then simplify.

red paper clips → $\frac{2}{6} = \frac{1}{3}$ ← blue paper clips (÷2 above and below)

The GCF of 2 and 6 is 2.

The ratio of red to blue paper clips is $\frac{1}{3}$, or 1 to 3, or 1:3. This means that for every 1 red paper clip there are 3 blue paper clips.

Got it? Do this problem to find out.

a. Write the ratio in simplest form that compares the number of suns to the number of moons. Then explain its meaning.

$\frac{2}{3}$; For every 2 suns, there are 3 moons.

Use Ratios to Compare Categorical Data

Each piece of categorical data can only be assigned to one group. Bar diagrams (or tape diagrams) and frequency tables can be used to represent categorical data. Ratios can be used to compare the data.

Examples

2. **Several students named their favorite flavor of candy. Write the ratio that compares the number who chose fruit to the total number of students.**

Favorite Flavor of Candy	
Flavor	Number of Responses
Peppermint	9
Cinnamon	8
Fruit	3
Spearmint	1

Fruit: 3

Total: 9 + 8 + 3 + 1, or 21

fruit flavor responses: $\frac{3}{21} = \frac{1}{7}$ (÷3) — The GCF of 3 and 21 is 3.

The ratio $\frac{1}{7}$ is 1 to 7, or 1:7.

So, 1 out of every 7 students preferred fruit-flavored gum.

3. **Monday's yogurt sales are recorded in the table. Write the ratio that compares the sales of strawberry yogurt to the total sales. Then explain its meaning.**

Flavor	Number Sold
Peach	3
Blueberry	6
Vanilla	7
Strawberry	8

Strawberry: 8

Total: 8 + 3 + 6 + 7, or 24

strawberry yogurt sold: $\frac{8}{24} = \frac{8 \div 8}{24 \div 8} = \frac{1}{3}$, or 1 to 3

So, 1 out of every 3 yogurt cups sold were strawberry.

Got it? **Do this problem to find out.**

b. A pet store sold the animals listed in the table in one week. Write the ratio of cats to pets sold that week. Then explain its meaning.

Pet	Number Sold
Birds	10
Turtles	14
Cats	8

$\frac{1}{4}$; 1 to 4, or 1:4; 1 out of every 4 pets sold were cats.

Accuracy

It is important to show the correct problem to check an answer. Incorrect answers can be informative.

Examples

2. **Use a ratio to compare categorical data.**

AL • *How many students were surveyed?* 9 + 8 + 3 + 1, or 21

• *How many students selected fruit?* 3

OL • *What ratio, in simplest form, compares the number of students who selected fruit to the total number of students?* $\frac{1}{7}$; 1 to 7; 1:7

BL • *What ratio compares the number of students who did not select peppermint to the total number of students? Write in simplest form.* $\frac{4}{7}$; 4 to 7; 4:7

Need Another Example?

Students were asked to name their favorite kind of book. Seven students chose sports, nine chose history, four chose mystery, and five chose fantasy. Write the ratio in simplest form that compares the number of students who chose fantasy books to the total number of students. $\frac{1}{5}$; 1 to 5, or 1:5

3. **Use a ratio to compare categorical data.**

AL • *What was the total number of sales?* 24

• *What was the number of strawberry sales?* 8

OL • *What ratio, in simplest form, compares the number of strawberry sales to the total sales?* $\frac{1}{3}$; 1 to 3; 1:3

BL • *What ratio compares the number of blueberry yogurts sold to the number of vanilla yogurts sold? Write in simplest form.* $\frac{6}{7}$; 6 to 7; 6:7

Need Another Example?

A department store conducted a study to determine what group shops in their store. Write the ratio that compares the number of customers that are 0–17 years to the total number of customers. $\frac{3}{22}$; 3 to 22, or 3:22

Age Group	Number
0–17	15
18–30	55
31–45	24
46+	16

Example

4. Use a ratio to divide into equal groups.

AL • *How does the bar diagram show the ratio of 2 to 3?* There are 2 bars in the top diagram and 3 bars in the bottom diagram.

OL • *If the total of the sections must be 30 flowers, how many flowers are in each section of the bar diagram?* 6 flowers

• *How many flowers need to be in each group?* 12 flowers in one group and 18 in the other group

BL • *Suppose Katy wanted to divide her 30 flowers into two groups, so that the ratio is 3 to 4. Is this possible? Explain.* no; The total bars would be 3 or 7, and 7 does not divide 30 evenly. Katy would not be able to put whole numbers of flowers into two groups with this ratio.

Need Another Example?

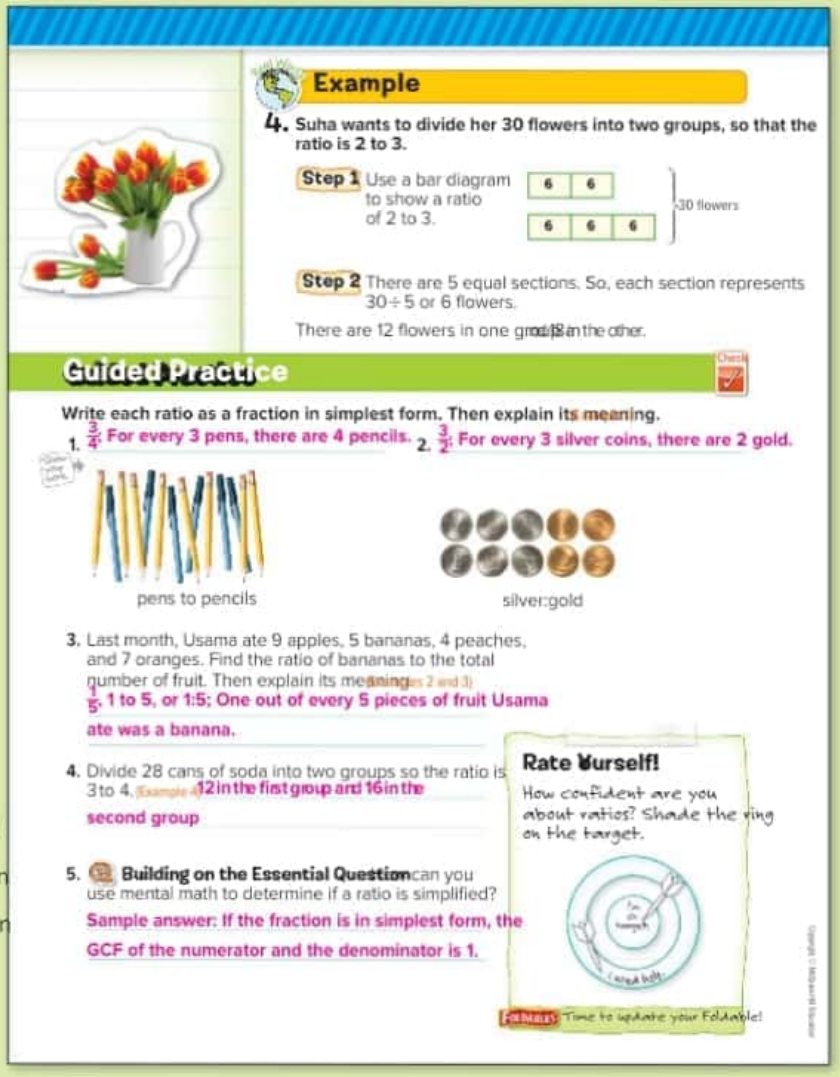
Divide 35 cans of food into two groups, so that the ratio is 3 to 4. 15 cans in the first group and 20 cans in the second group

Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Roundrobin** For Exercises 1–3, the first student in the group gives the name and number for the first part of the ratio. The second student tells whether the second part of the ratio should be the number of one of the items or the total number of items and then gives the second part of the ratio. The next student gives the ratio. The next student either simplifies the ratio or reports that it is already in simplest form. The last student expresses the ratio as a decimal, rounded to the nearest hundredth, if necessary. Then have students complete Exercises 4 and 5 together.



Example

4. Suha wants to divide her 30 flowers into two groups, so that the ratio is 2 to 3.

Step 1 Use a bar diagram to show a ratio of 2 to 3.

Step 2 There are 5 equal sections. So, each section represents 30 ÷ 5 or 6 flowers.

There are 12 flowers in one group and 18 in the other.

Guided Practice

Write each ratio as a fraction in simplest form. Then explain its meaning.

1. $\frac{3}{4}$; For every 3 pens, there are 4 pencils.
2. $\frac{3}{2}$; For every 3 silver coins, there are 2 gold.

pens to pencils

silver:gold

3. Last month, Usama ate 9 apples, 5 bananas, 4 peaches, and 7 oranges. Find the ratio of bananas to the total number of fruit. Then explain its meaning. (Examples 2 and 3)
$\frac{1}{5}$; 1 to 5, or 1:5; One out of every 5 pieces of fruit Usama ate was a banana.

4. Divide 28 cans of soda into two groups so the ratio is 3 to 4. (Example 4) 12 in the first group and 16 in the second group

5. **Building on the Essential Question** can you use mental math to determine if a ratio is simplified?
Sample answer: If the fraction is in simplest form, the GCF of the numerator and the denominator is 1.

Rate Yourself!

How confident are you about ratios? Shade the ring on the target.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Write each ratio as a fraction in simplest form. Then explain its meaning.

1. $\frac{2}{1}$; For every 2 flutes, there is 1 drum.
2. $\frac{2}{5}$; For every 2 sandwiches, there are 5 milk cartons.

flutes:drums

sandwiches to milk cartons

3. A nursery has 6 boys and 15 girls. What is the ratio of boys to girls?
(Example 2) $\frac{2}{5}$; For every 2 boys, there are 5 girls in the nursery.

4. The table shows the number of books Hammad has read. Find the ratio of mystery books to the total. Explain its meaning.

Type	Number of Books
Mystery	10
Nonfiction	7
Science Fiction	5
Adventure	2

$\frac{5}{12}$ 5 to 12, or 5:12; 5 out of every 12 books were mystery

5. Divide 33 photos into two groups so the ratio is 4 to 7.
12 photos in the first group and 21 photos in the second group

6. **Model with Mathematics** The graphic novel frame below shows an advertisement for three stores in the U.S. Use it to answer Exercises a–b.

a. For each store, what is the ratio of the number of cans to the price?
Super Saver $\frac{24}{\$9}$ Shop Smart $\frac{16}{\$7}$ Price Busters $\frac{8}{\$1}$

b. What would be the ratio of the number of cans to the price at Super Saver and Price Busters if a coupon for $1 off the total purchase is used? Super Saver $\frac{16}{\$3}$ Price Busters $\frac{8}{\$2}$

ENGAGE EXPLORE **EXPLAIN** **ELABORATE** **EVALUATE**

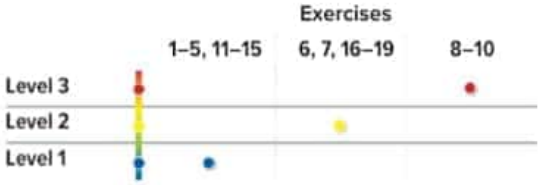
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–5, 7, 8, 10, 18, 19
OL	On Level	1–5 odd, 6–8, 10, 18, 19
BL	Beyond Level	6–10, 18, 19

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	9, 10
3 Construct viable arguments and critique the reasoning of others.	17
4 Model with mathematics.	6, 8
5 Use appropriate tools strategically.	7

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

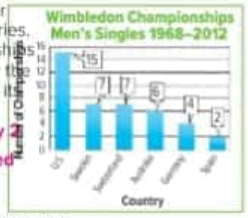
TICKET
Out the Door

Draw two triangles, four squares, and six circles on the board. Ask students to write the ratio of squares to total shapes in simplest form. 1:3.

Watch Out!

Common Error Remind students that ratios can express a part-to-part comparison or a part-to-whole comparison. You may want to have students write the ratio in terms of what is being asked and then fill in the numerical values as they apply.

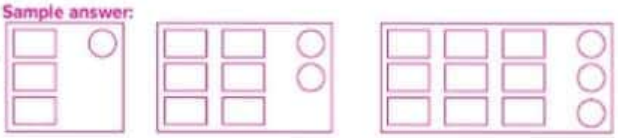
7. **Use Math Tools** The graph shows the number of Wimbledon championships of several countries.
   a. Write the ratio that compares the championships won by Australia to the total number won by the United States in simplest form. Then explain its meaning.
   $\frac{2}{5}$; 2 to 5, or 2:5; From 1968-2012, for every 2 championships won by Australia, the United States has won 5.



   b. Write the ratio that compares the championships won by Australia to the total number of championships. Then explain its meaning.
   $\frac{6}{41}$; 6 to 41, or 6:41; Between 1968 and 2012, Australia has won 6 of the 41 championships.

H.O.T. Problems Higher Order Thinking

8. **Model with Mathematics** Create three different drawings showing a number of rectangles and circles in which the ratio of rectangles to circles is 3:1.
   Sample answer:



9. **Persevere with Problems** Find the missing number in the following pattern. Explain your reasoning.
   12, 24, 72, 288, 1,440
   The ratios are 1:2, 1:3, 1:4, and 1:5.

10. **Persevere with Problems** The table shows how Jamal spends his time at the gym. Over the course of a week, he wants to spend 600 minutes at the gym. How much more time will he spend lifting weights than on the treadmill? Explain your reasoning.

Activity	Time (min)
Treadmill	25
Lifting weights	35

100 min; He spends 60 minutes on the treadmill and lifting weights. The ratio of time he spends on the treadmill is 25:60 or 250:600. So, he will spend 250 minutes on the treadmill and 350 minutes lifting weights. He will spend 350 − 250 or 100 more minutes.

Name _____ My Homework _____

Extra Practice

Write each ratio as a fraction in simplest form. Then explain its meaning.

11. $\frac{1}{4}$; for every 1 triangle there are 4 rectangles

triangles to rectangles

There are 2 triangles and 8 rectangles.

The ratio is $\frac{2}{8} \div \frac{2}{2} = \frac{1}{4}$

12. $\frac{3}{5}$; For every 3 soccer balls there are 5 American footballs.

soccer balls:American footballs

13. An animal shelter has 36 kittens and 12 bunnies available for adoption. What is the ratio of bunnies to kittens?

$\frac{1}{3}$; For every 1 bunny, there are 3 kittens available for adoption.

14. Find the ratio of black cell phone covers sold to the total number of cell phone covers sold last week. Then explain its meaning.

Color	Number of Cell Phone Covers Sold
Green	5
Silver	6
Red	3
Black	4

$\frac{2}{9}$; 2 to 9, or 2:9; 2 out of every 9 phone covers sold were black.

15. On the first day of the food drive, Mrs. Fatima's classes brought in 6 cans of fruit, 4 cans of beans, 7 boxes of noodles, and 4 cans of soup. Find the ratio of cans of fruit to the total number of food items collected. Then explain its meaning.

$\frac{2}{7}$; 2 to 7, or 2:7; Two out of every 7 food items donated were cans of fruit.

16. The rise and span for a roof are shown. The pitch of a roof is the ratio of the rise to the half-span. If the rise is 8 m and the span is 30 m, what is the pitch in simplest form?

$\frac{8}{15}$

17. **Justify Conclusions** Mboza found that 6 of the 24 students in her class own a cell phone. What is the ratio of students that own a cell phone to students that do not? Explain your reasoning to a classmate.

$\frac{1}{3}$; 1:3; or 1 to 3; Sample answer: If 6 students own a cell phone, 24 − 6 or 18 do not. The ratio is $\frac{6}{18}$ or $\frac{1}{3}$.

Power Up! Test Practice

Exercises 18 and 19 prepare students for more rigorous thinking needed.

18.

This test item requires students to reason abstractly and quantitatively when problem solving.	
Depth of Knowledge	DOK2
Mathematical Practices	MP1, MP4, MP6
Scoring Rubric	
2 points	Students correctly identify all 6 ratios.
1 point	Students correctly identify 4 or 5 ratios.

19.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP4
Scoring Rubric	
1 point	Student must write $\frac{7}{50}$ for credit.

Power Up! Test Practice

18. At a putt-putt course there are 50 yellow golf balls, 45 red golf balls, 65 blue golf balls, 40 orange golf balls, and 60 green golf balls. Select the correct ratio to complete the table.

8:13	4:5
5:6	3:4
10:9	12:13

Comparison	Ratio
yellow to red	10:9
yellow to green	5:6
green to blue	12:13

Comparison	Ratio
red to green	3:4
orange to yellow	4:5
orange to blue	8:13

19. The table shows the number of each type of sports card that Lamya has collected.

baseball	basketball	football	soccer
45	14	20	21

Write a ratio in simplest form that compares the number of basketball cards to the total number of cards. $\frac{7}{50}$

Spiral Review

Find the equivalent fraction.

20. $\frac{3}{7} = \frac{9}{21}$

21. $\frac{1}{6} = \frac{4}{24}$

22. $\frac{4}{5} = \frac{28}{35}$

23. Ahmed's family is going on vacation. If they drive for 3 hours at the posted speed, how many kilometers will they travel?

195 kilometers

24. Abdullah made $\frac{3}{5}$ of the baskets he shot. Suppose he shot 60 baskets. How many did he make?

36 baskets

25. There are 36 students in Mrs. Salama's sixth grade class. If $\frac{5}{12}$ of the students are girls, how many girls are in the class?

15 girls

Inquiry Lab
Unit Rates

Inquiry **HOW can you use bar diagrams to compare quantities in real-world situations?**

MP Mathematical Practices 1, 3, 8

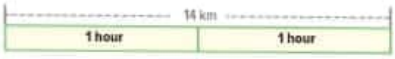
Jamila and Amira were rollerblading. They skated 14 kilometers in 2 hours. If they skated at a constant rate, how many kilometers did they skate in 1 hour?

What do you know? Jamila and Amira skated 14 kilometers in 2 hours.

What do you need to find? the number of kilometers they skated in 1 hour

Hands-On Activity 1

Step 1 Use a bar diagram to represent 14 kilometers. The box is separated into two equal sections to represent 2 hours.



Step 2 Each section represents one hour. Determine the number of kilometers skated in one hour.

So, they skated 7 kilometers in one hour.

Focus narrowing the scope

Objective Use models to find unit rates.

Coherence connecting within and across grades

Now Students use and draw bar diagrams to find unit rates.

Next Students will give examples of rates.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 29.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lab

Activities 1–3 are intended to be used as whole-group activities. Activity 1 is designed to provide more guidance to students than Activities 2 and 3.

Hands-On Activity 1

AL LA **Rally Robin** Place students in small groups to respond to the following questions. Students discuss their response in their group. Then the groups take turns responding orally by selecting a spokesperson. MP 1, 3

Ask:

- *In Step 1, why is the bar diagram separated into 2 equal sections?* To represent 2 hours
- *In Step 2, how do we determine that the number of miles skated in one hour is 7?* Divide 14 by 2.
- *How can you check that your answer is reasonable?* Sample answer: Multiply 7 by 2 to get 14, or add 7 to get 14.

Hands-On Activity 2

AL LA **Rally Robin** Have students continue to work in the same group as Activity 1. Each question should be posed aloud and students discuss their response in their group. Then the groups take turns responding orally, by selecting a spokesperson. MP 1, 3

Ask:

- *In Step 1, why is the bar diagram separated into 5 equal sections?* To represent 5 crackers
- *In Step 2, how do we find the number of Calories in 1 cracker?* Divide 205 by 5.
- *How can you represent 205 Calories in 5 crackers as a ratio, not in simplest form?* $\frac{205}{5}$; 205 to 5; 205:5

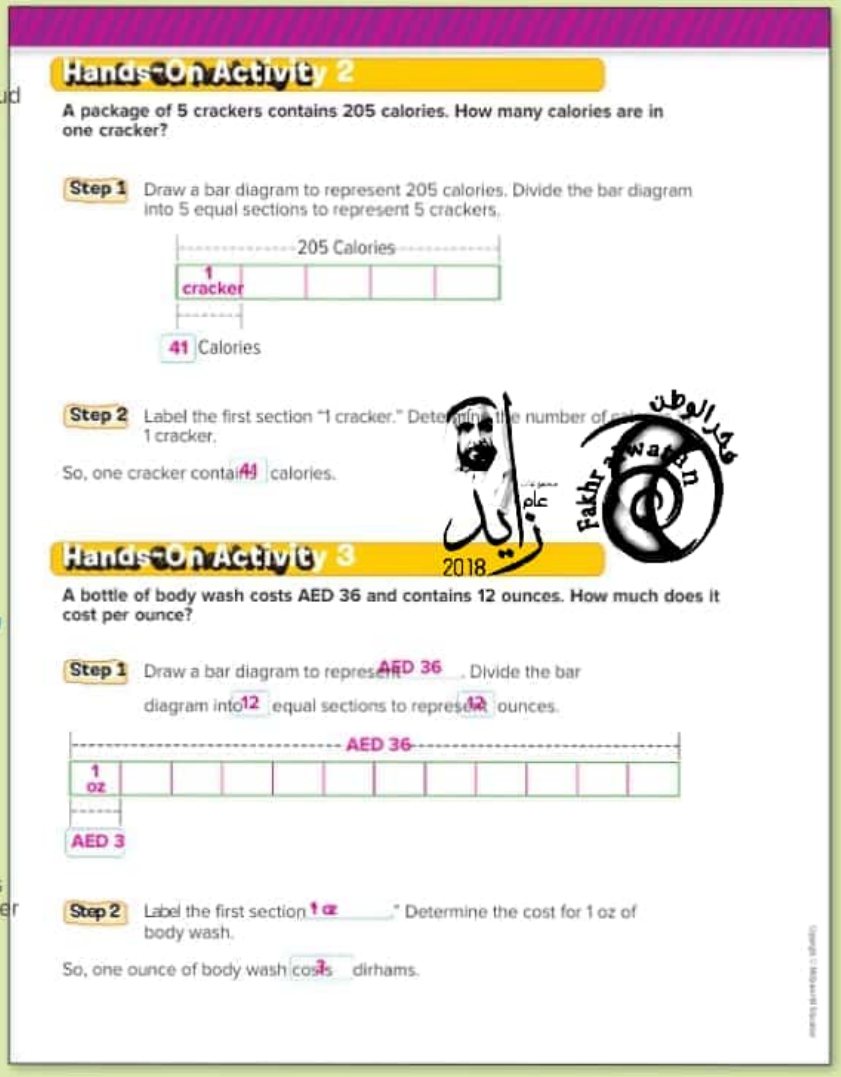
BL LA **Pairs Discussion** Have students work in pairs to respond to the following questions. Have them justify their response for each question. MP 1, 3

Ask:

- *How can you use the bar diagram to find the number of Calories in 3 crackers?* Each cracker contains 41 Calories, so multiply 41 by 3. Three crackers contain 123 Calories.
- *How can you find the number of Calories there would be in 3 packages of crackers?* One package of crackers contains 205 Calories, so multiply 205 by 3. Three packages contain 615 Calories.

Hands-On Activity 3

BL LA **Pairs Consult** Have students use the Internet or another source to locate an item that is for sale. The item should list the sale price and the number of ounces (or other measurement unit) contained in the item. Then have students draw a bar diagram that can be used to determine the cost per ounce (or other measurement unit). MP 1, 5



Hands-On Activity 2

A package of 5 crackers contains 205 calories. How many calories are in one cracker?

Step 1 Draw a bar diagram to represent 205 calories. Divide the bar diagram into 5 equal sections to represent 5 crackers.

205 Calories

1 cracker

41 Calories

Step 2 Label the first section "1 cracker." Determine the number of calories in 1 cracker.

So, one cracker contains 41 calories.

Hands-On Activity 3

A bottle of body wash costs AED 36 and contains 12 ounces. How much does it cost per ounce?

Step 1 Draw a bar diagram to represent AED 36. Divide the bar diagram into 12 equal sections to represent 12 ounces.

AED 36

1 oz

AED 3

Step 2 Label the first section "1 oz." Determine the cost for 1 oz of body wash.

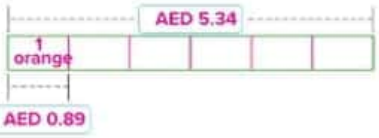
So, one ounce of body wash costs 3 dirhams.

Investigate

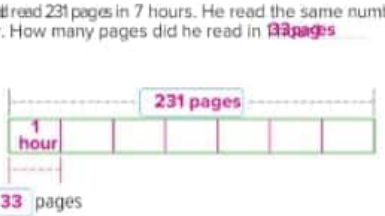
Work with a partner to solve. Use a bar diagram.

1. Issa drove 129 kilometers in 3 hours. He drove at a constant speed. How many kilometers did he drive in 1 hour? 43 km

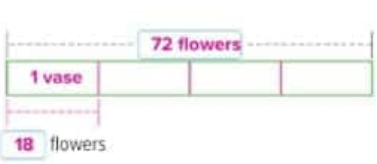
2. Six oranges cost AED 5.34. How much does 1 orange cost? AED 0.89



3. Khalid read 231 pages in 7 hours. He read the same number of pages each hour. How many pages did he read in 1 hour? 33 pages



4. Maha has 72 flowers in 4 vases. She put the same number of flowers in each vase. How many flowers are in 1 vase? 18 flowers

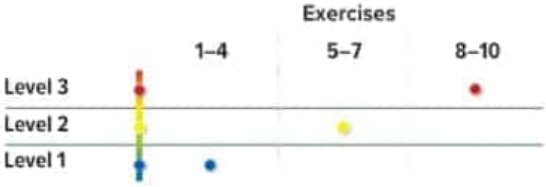


2 Collaborate

The **Investigate** and **Analyze and Reflect** tions are intended to be used as small-group investigati **Create** e section is intended to be used as independent exercises.

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Leve indicating the lowest level of complexity.



Investigate

AL LA **Think-Pair-Sol** ave students think through their response to Exercise 1. Then have them discuss their resp with a partner, without recording anything. They should di the number of divisions they should draw on the bar diag and how to determine the numerical value of each divisio Then have them individually complete Exercise 1. Have th repeat this process for each of Exercis 1–4.

BL LA **Find the Fib** ave students work with a partner to create two facts and one fib for each exercise. For examp one fact for Exercise 1 could be that Travis drove 43 miles one hour. One fib for Exercise 1 could be that Travis drove miles in two hours. Have pairs share their facts and fibs w another pair of students. Each pair should identify the fact fibs of the other p 1, 3

Analyze and Reflect

AL LA **Pairs Discussion** Have students work in pairs to complete Exercises 5 and 6. Give them play coins that they can use to physically manipulate the objects. Have them respond to the following guiding questions.

Ask:

- *How many different types of coins are there?* 2; quarters and dimes
- *How many quarters are there altogether?* 13; 13
- *How many quarters should be in each group?* 1; 1

BL LA Have students alter the scenario in Exercise 5 so that the container of cookies contains 12 servings. Have student discuss how they can determine the new cost per serving, to the nearest penny. 3

Create

BL LA **Roundtable Consensus** Have students work in small groups to complete Exercise 8. Each student should write their own rule, then share with the group. Group members must show agreement (thumbs up) or disagreement (thumbs down) for each rule. If there is disagreement, the group members discuss how the rule is incorrect and how it could be altered to be correct. MP 1, 2, 3

Inquiry Students should be able to answer "HOW can you use bar diagrams to compare quantities in real-world situations?" Check for student understanding and provide guidance, if needed.

Analyze and Reflect

Work with a partner to complete the problem.

5. In the bakery, a container of cookies is AED 12.75 and contains 3 servings. The coins below equal AED 12.75. Divide the coins into 3 equal groups to determine the cost per serving. Circle each group. AED 4.25

6. MP **Reason Inductively** How does dividing the coins into equal groups help solve the problem?
Circling the equal groups gives the cost per serving and counting the 3 circled groups checks my work.

7. MP **Justify Conclusions** The comparison of kilometers to hours in Activity 1 is 14:2, which can be reduced to 7:1. How is simplifying similar to division?
Sample answer: When simplifying a ratio, you could divide common factors. Since 14 ÷ 7 = 7 and 2 ÷ 2 = 1, the ratio can be simplified to 7:1.

Create

Sample answers: 10

8. MP **Identify Repeated Reasoning** Write a rule for how to compare two quantities so that the second quantity has a value of 1 without using a diagram.
When the second number is a factor of the first number, divide the first number by the second number.

9. MP **Model with Mathematics** Write a real-world word problem in which the unit rate is 6 kilometers per hour.
Rashid inline skated 12 kilometers in 2 hours. He skated at a constant speed. How many kilometers did he inline skate in 1 hour? 6 km

10. Inquiry HOW can you use bar diagrams to compare quantities in real-world situations? **You can use bar diagrams to compare the total number of kilometer driven on a three-hour trip to the number of kilometer driven in one hour.**

Ratios and Proportional Relationships

Lesson 3 Rates

Vocabulary Start-Up

Use your glossary, which starts on page GL1, to complete the definitions of the vocabulary words in the table.

Definition	Examples
fraction: A number that represents a part of a whole or part of a set.	$\frac{1}{2}, \frac{2}{4}, \frac{45}{12}, \frac{9}{3}$
ratio: A comparison of two quantities by division.	2 out of 3, 2 to 3, $\frac{2}{3}$,
rate: A ratio comparing two quantities with different kinds of units.	$\frac{36 \text{ km}}{3 \text{ hrs}}$ 36 km for every 3 hours AED 26 for 5 bags 19 songs in 5 minutes
unit rate: A rate that is simplified so that it has a denominator of 1.	12 km / 1 hour, 12 km per hour AED 5.20 for 1 bag 3.8 songs in 1 minute

Essential Question

HOW do you use equivalent rates in the real world?

Vocabulary

rate
unit rate
unit price

Mathematical Practices

1, 3, 4

Real-World Link

Amani typed a 15-character text message in 5 seconds.

1. Write the rate Amani typed as a fraction. $\frac{15 \text{ characters}}{5 \text{ seconds}}$

2. What operation would you use to write the fraction in simplest form? division

Which Mathematical Practices do you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Focus narrowing the scope

Objective Give examples of rates and write rates as unit rates.

Coherence connecting within and across grades

Previous	Now	Next
Students gave examples of rates and used models to find unit rates.	Students give examples of rates and find unit rates.	Students will solve real-world problems using ratio tables.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 35.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Numbered Heads Together** re groups of students complete the activity. Assign each stud a number. Have groups discuss how to complete the activ ensuring that every group member understands. Call on a specific number to share their responses with the class. MP 1, 3, 5

Alternate Strategies

AL LA Provide students with a word bank of terms that they can use to complete the ac MP 1, 6

BL LA Discuss the use of the word and how it is used when describing a rate. Ask them to think of other ways w can express the same idea, such as 60 miles an hour, or 4 cookies for every stud MP 1, 6

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Write a rate as a unit rate.

AL • *How can you write the rate as a fraction?* 45 oranges / 5 minutes

• *How can you write the rate as a unit rate?* Divide the numerator and denominator by 5.

OL • *What is the unit rate?* 9 oranges / 1 minute

• *At this rate, how many oranges could Samantha pick in 12 minutes? How does the unit rate help you find the answer?* 108 oranges; I can multiply the unit rate by any number of minutes.

BL • *At this rate, how many seconds will it take Samantha to pick 12 oranges?* She can pick 9 oranges in 60 seconds or 3 oranges in 20 seconds. So she can pick 12 oranges in 20 + 20 + 20 + 20 or 80 seconds.

Need Another Example?
Maryam reads 1,000 words in 5 minutes. Write this rate as a unit rate. 200 words per minute

2. Write a rate as a unit rate.

AL • *How can you write the rate as a fraction?* 18 km / 30 minutes

• *What is the GCF of 18 and 30?* 6

OL • *Is* 3 km / 5 minutes *a unit rate? Explain.* No; The rate does not have a denominator of 1.

• *How would you write* 3 km / 5 minutes *as a unit rate?* Divide both the numerator and denominator by 5.

BL • *Are the rates* 3 km / 5 minutes *and* 3/5 *kilometer to 1 minute equivalent? Explain.* Yes; Sample answer: If you divide both the numerator and denominator of 3 km / 5 minutes by 5, you will get the comparison 3/5 kilometer to 1 minute.

Need Another Example?
Noora earned AED 675 last week. If she worked 18 hours, how much was she paid per hour? AED 37.50

Work Zone

Simplifying Ratios

a. 7 songs per minute

b. Kareem used 3/4 liter of water per cup of flour.

Find a Unit Rate

A **rate** is a ratio comparing two quantities of different kinds of units. A **unit rate** has a denominator of 1 unit when the rate is written as a fraction. To write a rate as a unit rate, divide the numerator and the denominator of the rate by the denominator.

Ratio	Rate	Unit Rate
15:5 =	15 characters / 5 seconds =	3 characters / 1 second

Examples

Hala picked 45 oranges in 5 minutes. Write this rate as a unit rate.

Write the rate as a fraction.
Compare the number of oranges to the number of minutes.
Then divide.

45 oranges / 5 minutes = 9 oranges / 1 minute (÷5)

So, the unit rate is 9 oranges / 1 minute or 9 oranges per minute.

2. The Australian dragonfly can travel 18 kilometers in 30 minutes. How far can the dragonfly travel in 1 minute?

Write the rate as a fraction.
Compare the distance to the number of minutes. Then divide.

18 km / 30 minutes = 3 km / 5 minutes (÷6)

The ratio 3 to 5 cannot be simplified to a whole number rate. It can be written as 3 km / 5 minutes or as a unit rate 3/5 km to 1 minute.

The dragonfly can travel 3/5 km every minute.

Get It? Do these problems to find out.

a. Amna downloaded 35 songs in 5 minutes. How many songs did she download per minute?

b. Kareem is baking several loaves of bread to sell in his bakery. He used 9 liters of water and 12 cups of whole wheat flour. How much water was used per liter of flour?

Example

3. **An adult's heart beats about 2,100 times every 30 minutes. A baby's heart beats about 2,600 times every 20 minutes. How many more beats does a baby's heart beat in 60 minutes than an adult's heart?**

Step 1 Find the unit rates.

Adult: $\frac{2,100 \text{ beats}}{30 \text{ minutes}}$ or $\frac{70 \text{ beats}}{1 \text{ minute}}$

Baby: $\frac{2,600 \text{ beats}}{20 \text{ minutes}}$ or $\frac{130 \text{ beats}}{1 \text{ minute}}$

Step 2 Using the unit rate for each, determine the number of beats in 60 minutes.

Adult: $70 \times 60 = 4,200$ beats

Baby: $130 \times 60 = 7,800$ beats

Step 3 Find the difference.

$7,800 - 4,200 = 3,600$

So, a baby's heart beats 3,600 more times in 60 minutes than an adult's heart.

Key Phrases

Got it? **Do this problem to find out.**

c. A hummingbird's heart rate while resting is about 7,500 beats every 30 minutes. How many more beats does a hummingbird's heart beat in 60 minutes than a human baby's heart?

c. 7,200 more beats

Find a Unit Price

You can use what you know about unit rates to find a unit price. The **unit price** is the cost per unit. To write a price as a unit price, divide the numerator and the denominator of the rate by the denominator.

$$\frac{\text{AED } 36}{4 \text{ tickets}} = \frac{\text{AED } 9}{1 \text{ ticket}}$$

(÷4 on both sides)

For example, it costs AED 36 for 4 movie tickets. So, the cost per unit, or per ticket, is AED 9.

Example

3. **Use unit rates to compare.**

AL
- *Why can we not just compare the number of beats 2,100 and 2,600?* The number of minutes is different.
- *What ratio compares the number of adult heartbeats to the number of minutes?* $\frac{2,100}{30}$; 2,100 to 30; or 2,100:30
- *What ratio compares the number of baby heartbeats to the number of minutes?* $\frac{2,600}{20}$; 2,600 to 20; or 2,600:20

OL
- *What are the unit rates?* adult: $\frac{70 \text{ beats}}{1 \text{ min}}$; baby: $\frac{130 \text{ beats}}{1 \text{ min}}$
- *Now that we know the unit rates, how can we find the number of beats for each in 60 minutes?* Multiply 70 by 60 and multiply 130 by 60.
- *How many heartbeats does the adult heart beat in 60 minutes? a baby's heart?* 4,200 beats; 7,800 beats
- *How many more beats does a baby's heart beat in 60 minutes than an adult's heart?* 3,600 beats

BL
- *Describe another way you can solve this problem.* Sample answer: Find the difference in the unit rates. A baby's heart beats 130 − 70, or 60 more beats in one minute than an adult's heart. Multiply this number by 60 to get the difference in heart beats for 60 minutes. $60 \times 60 = 3,600$

Need Another Example?

A cat's heart beats about 3,600 beats every 30 minutes. A horse's heart beats about 1,320 times every 30 minutes. How many more beats does a cat's heart beat in 60 minutes than a horse's heart? 4,560 times

Example

4. **Find the unit price.**

AL • *How can you write the rate as a fraction?*
$\frac{88}{4}$

• *How can you write the rate as a unit rate?* Divide the numerator and denominator by 4.

OL • *What is the unit price?* AED 22.00

• *How much would five potted plants cost, at this rate? How does the unit price help you find the answer?* AED 110.00; By first finding the unit price, I can multiply that price by the any number of plants.

BL • *If a different store charges AED 70.50 for three potted plants, which store offers the better price? Explain.* The first store; The second store charges AED 23.50 per potted plant, which is more than the unit price at the first store.

Need Another Example?
Hassan spent AED 96 on four concert tickets. How much was each ticket? AED 24

Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Think-Pair-Share** Give students a few minutes to think through their solutions for Exercises 1–6. Then ask pairs of students to work together to determine the solution. Call on one pair of students to share their solutions with the class for each exercise. 1, 3

BL LA **Find the Fib** Have students work with a partner to write two facts and one fib for Exercise 6. Then have them exchange facts and fibs with another pair of students. Each pair identifies the other pair's fact and fib.

Example

4. **Financial Literacy** Four potted plants cost AED 88. What is the price per plant?

Write the rate as a fraction. Compare the total cost to the number of plants. Then divide.

$$\frac{\text{AED } 88}{4 \text{ plants}} = \frac{\text{AED } 22}{1 \text{ plant}}$$

÷4 ÷4

So, the price per potted plant is AED 22.

Guided Practice

Check

Write each rate as a unit rate. (Examples 1 and 2)

1. 44 points in 4 quarters: 11 points / 1 quarter
2. 125 m in 5 seconds: 25 m / 1 s
3. 360 km traveled on 12 liters of gasoline: 30 km per liter
4. 12 meters in 28 seconds: $\frac{3}{7}$ m per second
5. Nasser shot 20 baskets in 4 minutes. Ahmed shot 42 baskets in 6 minutes. How many more baskets did Ahmed shoot per minute? (Example 2) 2 baskets per minute
6. For Aisha's graduation, her mom took her and 4 friends to a water park. Aisha's mom paid AED 400 for 5 student tickets. What was the price for one student ticket? AED 80
7. **Building on the Essential Question** How are rates and ratios related? Sample answer: A rate is a ratio that compares two quantities with different kinds of units, such as miles per hour.

Rate Yourself!

- ☐ I understand how to find a unit rate. ▸▸ Great! You're ready to move on!
- ☐ I still have some questions about rates.

Name _____ My Homework _____

Independent Practice

Write each rate as a unit rate. (Examples 1 and 2)

1. 72 oz in 6 cans — 12 oz / 1 can

2. 162 water bottles in 9 cases — 18 water bottles per case

3. Mahmoud divided 40.8 liters of paint among 8 containers. How much paint is in each container? (Example 1) — 5.1 liters / 1 container

4. Central Subs made 81 sandwiches using 360 grams of turkey. How much turkey was used per sandwich? (Example 2)
They used 40/9 grams of turkey per sandwich.

5. The results of a car race are shown. Determine who drove the fastest. Explain. (Example 3)
Divide the time by the number of laps.
Evans drove the fastest at 2.3 minutes per lap.

Drivers' Times		
Driver	Laps	Time (min)
Majid	35	84
Tarek	42	96.6
Fahim	38	102.6

6. Tarek's mom bought an eight-pack of juice boxes at the store for AED 4. Find the unit rate for the juice boxes. (Example 4) — AED 0.50 for 1 juice box

7. Hassan's cousin pledged AED 12 for a charity walk. If Hassan walked 3 kilometers, how much did his cousin pay per kilometer?
AED 4 per km

8. **Justify Conclusions** The Lovin' Lemon Company sells a 4-liter jug of lemonade for AED 24. The Sweet and Sour Company sells an eight-pack of 250 ml bottles of lemonade for AED 16. Which company has a higher unit price? Explain your answer.
Sweet and Sour Company; Sample answer: The unit price is AED 2 per pack compared to AED 1.50 at the Lovin' Lemon Company.

9. The Shanghai Maglev Train is one of the fastest trains in the world, traveling about 2,144 miles in 8 hours.
   a. How many miles does it travel in one hour? — 268 miles
   b. The distance between Columbus, Ohio, and New York City is about 560 miles. How many hours would it take the train to travel between the cities? — about 2 h

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

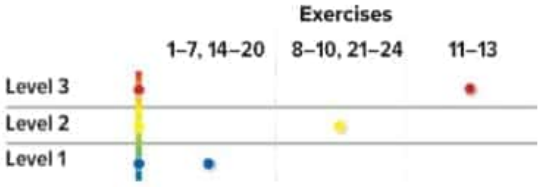
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–7, 9, 11, 13, 23, 24
OL	On Level	1–5 odd, 7–11, 13, 23, 24
BL	Beyond Level	7–13, 23, 24

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	12
3 Construct viable arguments and critique the reasoning of others.	8, 10, 11, 13

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Tell students that the next lesson focuses on using ratio tables to find ratios. Ask them to write a few sentences on how they think the lessons on ratios and rates prepare them for using ratio tables. Have them use the writing prompts below. See students' work.

- In the previous lesson, I learned...
- In this lesson, I learned...
- What I learned in this lesson and in the previous lesson will help me in the next lesson because...

Watch Out!

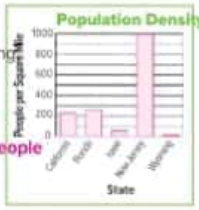
Common Error A unit rate has a denominator of 1. Encourage students to think of a unit rate as the cost, distance, and time, for every one unit of the denominator.

10. **Multiple Representations** The table shows the approximate population and areas of five states. *Population density* is the number of people per square unit of an area.

State	Population Estimate (as of July 2007)	Area (square miles)
California	36,500,000	163,707
Florida	18,300,000	65,758
Iowa	2,990,000	56,276
New Jersey	8,690,000	8,722
Wyoming	522,000	97,818

a. **Numbers** Find the population density of each state. Round to the nearest tenth.
California: 223.0 people/sq mi; Florida: 278.3 people/sq mi; Iowa: 53.1 people/sq mi; New Jersey: 996.3 people/sq mi; Wyoming: 5.3 people/sq mi

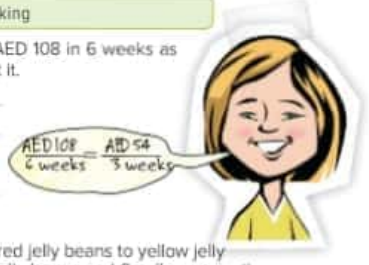
b. **Graph** Make a bar graph of the five population densities.



c. **Words** Connecticut has about the same population as Iowa, but its area is 4,875 square miles. Without calculating, compare Connecticut's population density to Iowa's. Justify your answer.
Sample answer: Connecticut has a higher population density because approximately the same number of people are distributed among a smaller space.

H.O.T. Problems Higher Order Thinking

11. **Find the Error** Liyam wrote the rate AED 108 in 6 weeks as a unit rate. Find her mistake and correct it.
A unit rate has a denominator of 1.
$\frac{\text{AED } 108}{6 \text{ weeks}} = \frac{\text{AED } 18}{1 \text{ week}}$



12. **Persevere with Problems** The ratio of red jelly beans to yellow jelly beans in a dish is 3:4. If Ali eats 3 red jelly beans and 6 yellow ones, the ratio is 4:5. How many yellow jelly beans were originally in the dish?
36 yellow jelly beans

13. **Justify Conclusions** If you travel at a rate of 45 kilometers per hour, how many minutes will it take you to travel 1 kilometer? Justify your response.
$1\frac{1}{3}$ min, or 1 min, 20 s; 45 km = 45 km per s, so $\frac{60}{45}$ gives the seconds per kilometer

Name _____ My Homework _____

Extra Practice

Write each rate as a unit rate.

14. Jamal printed 24 photos in 8 minutes. How many photos did he print per minute?

3 photos per minute

$\frac{24 \text{ photos}}{8 \text{ minutes}} = \frac{3 \text{ photos}}{1 \text{ minute}}$

15. Ghaya planted 48 tulips in 12 minutes. How many tulips did she plant per minute?

4 tulips per minute

16. Hamad decorated 72 cookies in 36 minutes. How many cookies did he decorate per minute?

2 cookies per minute

17. Amal biked 45 miles in 3 hours. How many miles did she bike per hour?

15 miles per hour

18. A Ruby Throated Hummingbird beats its wings 159 times in 3 seconds. How many times does the Ruby Throated Hummingbird beat its wings per second?

53 beats per second

19. The Al Shuhhi family bought four concert tickets for AED 252. What was the price per ticket?

AED 63 per ticket

20. An adult blinks about 450 times in 30 minutes. A 12-year-old blinks about 150 times in 15 minutes. How many more times does an adult blink in 60 minutes than a 12-year-old?

300 blinks

21. Find the number of meters each record holder ran in one second of each event. Round to the nearest tenth.

a. 200 meters, 19.30 seconds, Usain Bolt, Jamaica

10.4 m per s

b. 400 meters, 43.18 seconds, Michael Johnson, USA

9.3 meters

c. 100 meters, 9.69 seconds, Usain Bolt, Jamaica

10.3 meters

22. **Justify Conclusions** The 24 students in Mr. Khalifa's homeroom sold 72 magazine subscriptions. The 28 students in Mrs. Yaqoob's homeroom sold 98 magazine subscriptions. Whose homeroom sold more magazine subscriptions per student? Explain your reasoning.

Mrs. Yaqoob; Mr. Khalifa's homeroom sold 3 subscriptions per student while Mr. Yaqoob's homeroom sold 3.5 subscriptions per student.

Power Up! Test Practice

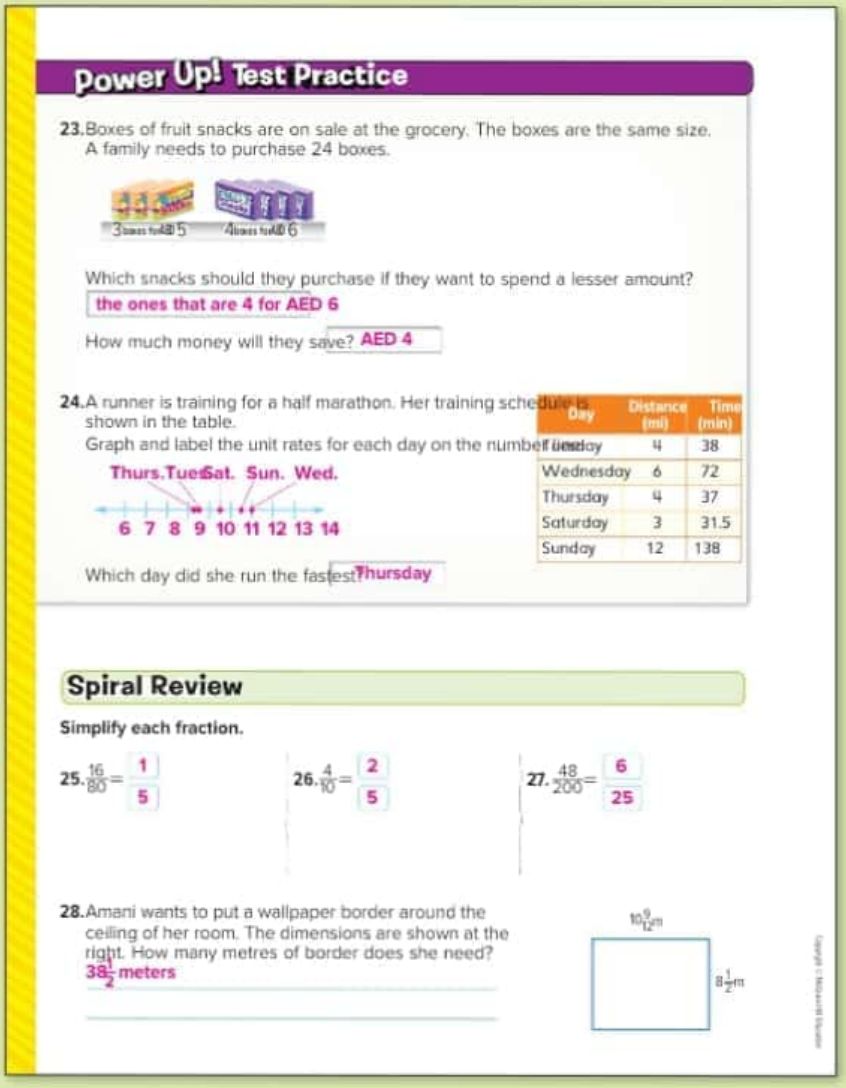
Exercises 23 and 24 prepare students for more rigorous thinking needed.

23.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK2
Mathematical Practice	MP6, MP7
Scoring Rubric	
2 points	The student identifies the snacks that are 4 for AED 6 and states how much will be saved.
1 point	The student correctly identifies which snacks should be purchased but fails to indicate how much will be saved.

24.

This test item requires students to analyze and solve complex real-world problems through the use of mathematical tools and models.	
Depth of Knowledge	DOK3
Mathematical Practices	MP1, MP4, MP6
Scoring Rubric	
2 points	Student correctly plots the rates AND Thursday is written in the answer box.
1 point	Student correctly plots the rates OR student writes Thursday in the answer box.



Power Up! Test Practice

23. Boxes of fruit snacks are on sale at the grocery. The boxes are the same size. A family needs to purchase 24 boxes.

Which snacks should they purchase if they want to spend a lesser amount?

the ones that are 4 for AED 6

How much money will they save? AED 4

24. A runner is training for a half marathon. Her training schedule is shown in the table.

Day	Distance (mi)	Time (min)
Tuesday	4	38
Wednesday	6	72
Thursday	4	37
Saturday	3	31.5
Sunday	12	138

Graph and label the unit rates for each day on the number line.

Which day did she run the fastest? Thursday

Spiral Review

Simplify each fraction.

25. $\frac{16}{80} = \frac{1}{5}$

26. $\frac{4}{10} = \frac{2}{5}$

27. $\frac{48}{200} = \frac{6}{25}$

28. Amani wants to put a wallpaper border around the ceiling of her room. The dimensions are shown at the right. How many metres of border does she need?

$3\frac{1}{2}$ meters

Lesson 4

Ratio Tables

Real-World Link

Refreshments A punch recipe uses one container of soda and three containers of juice to make one batch of punch.

1. Draw red counters to show the number of containers of soda and draw yellow counters to show the number of containers of juice needed to make 2 batches of punch.

soda → 2
juice → 6

2. Draw red counters to show the number of containers of soda and draw yellow counters to show the number of containers of juice needed to make 3 batches of punch.

soda → 3
juice → 9

3. Find the ratio in simplest form of soda to juice needed for 1, 2, and 3 batches. What do you notice?

1:3; The ratios 1:3, 2:6, and 3:9 are equivalent.

Essential Question

HOW do you use equivalent rates in the real world?

Vocabulary

ratio table
equivalent ratios
scaling

Mathematical Practices
1, 3, 4, 7, 8

Which Mathematical Practices do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Use tables to solve problems involving ratios and rates.

Coherence connecting within and across grades

Previous	Now	Next
Students gave examples of rates and found unit rates.	Students represent problems involving ratios and rates with tables.	Students will represent real-world problems involving ratios and rates with graphs.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 43.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA Numbered Heads Together e students work in groups to complete Exercises 1–3. Each student is assigned a number. Each group member shoul questions to ensure their own understanding as well as provide assistance to other group members, so that all gr members understand how the ratios 2:6 and 3:9 are equi to 1:3 MP 1, 5

Alternate Strategy

BL Tell students that in a bowl of bananas and apples, th ratio of apples to the total pieces of fruit is 2:8. Ask them determine the ratio of bananas to apples. Then have them write the ratio in simplest f MP 5

6:2, 3:1

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Use a ratio table and equivalent ratios to solve a real-world problem.

AL • *What ratio represents the quantities that we know?*
6 drops of food coloring to 1 cup of icing

• *What are we trying to find?* the number of drops of food coloring to mix with 5 cups of icing

OL • *Why do we multiply each quantity by 5?* $1 \times 5 = 5$

• *How many drops of food coloring do we need to mix with 5 cups of icing?* 30 drops

BL • *If you mixed 35 drops of food coloring with 5 cups of icing, would the resulting color be lighter, the same, or darker than the original yellow icing? Explain.* Darker; The concentration of food coloring is greater.

Need Another Example?
A recipe calls for 5 cups of water for each cup of black beans. How many cups of water should be used for 4 cups of black beans? 20 cups

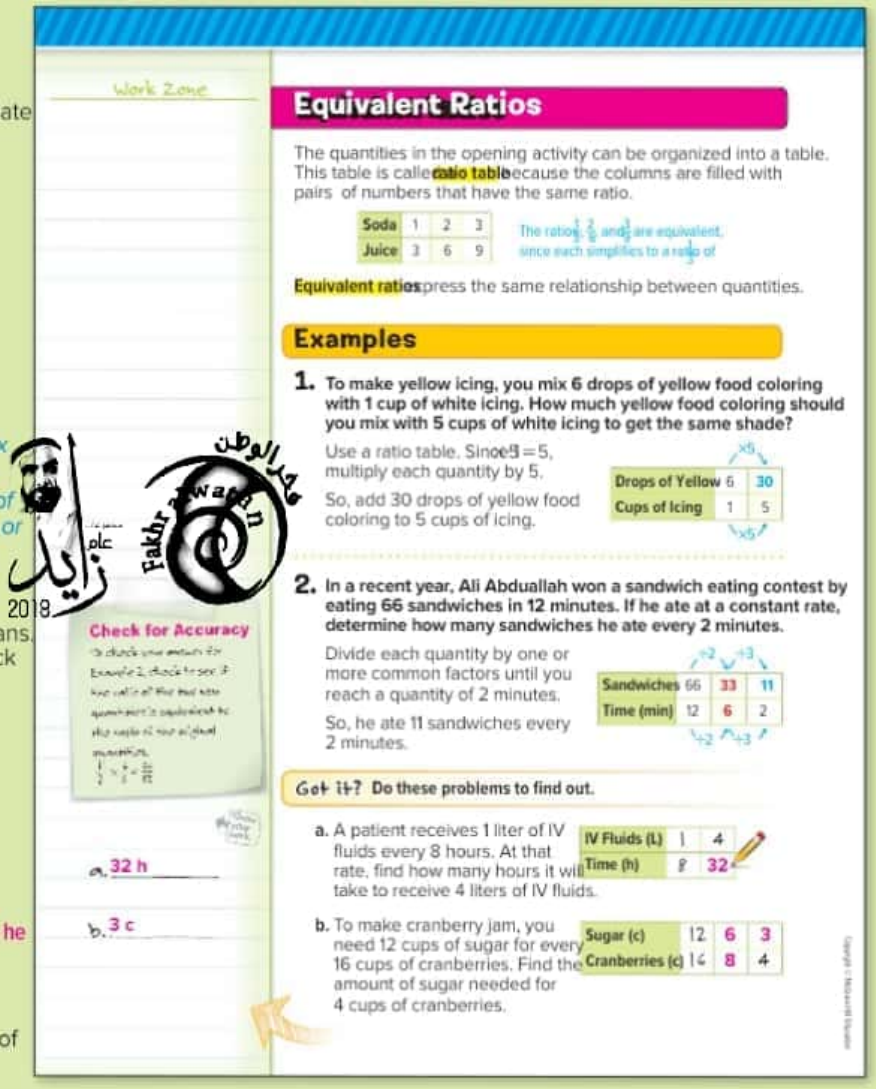
2. Use a ratio table and equivalent ratios to solve a real-world problem.

AL • *What ratio represents the quantities that we know?*
66 sandwiches to 12 minutes

OL • *Why do we divide?* We need to reach a quantity of 2 minutes, and we started with 12 minutes.

BL • *About how many seconds did it take Joey to eat each sandwich? Explain.* He can eat 11 sandwiches in 2 minutes, so he can eat about 5.5 sandwiches in 60 seconds. This means he can eat each sandwich in about 60, or about 11 seconds.

Need Another Example?
There are 50 petals on 10 orange blossoms. Each orange blossom has the same number of petals. Find the number of petals on one orange blossom. 5 petals



Use Scaling

Multiplying or dividing two related quantities by the same number is called **scaling**. Sometimes you may need to scale back and then scale forward to find an equivalent ratio.

Examples

3. **Cans of corn are on sale at 10 for AED 4. Find the cost of 15 cans.**

Cans of Corn	10		15
Cost in AED	4		■

There is no whole number by which you can multiply 10 to get 15. So, scale back to 5 and then scale forward to 15.

Cans of Corn	10	5	15
Cost in AED	4	2	6

Divide each quantity by a common factor, 2.

Then, since 5 · 3 = 15, multiply each quantity by 3.

So, 15 cans of corn would cost AED 6.

4. **Humaid mows lawns during his summer vacation to earn money. He took 14 hours last week to mow 8 lawns. At this rate, how many lawns could he mow in 49 hours?**

Is there a whole number by which you can multiply 14 to get 49? no

Scale back to 7, and then scale forward to 49.

Number of Hours	14	7	49
Number of Lawns	8	4	28

So, Humaid can mow 28 lawns in 49 hours.

Got it? **Do this problem to find out.**

c. A child's height measures 105 centimeters. Estimate her height in inches.

Height (cm)	25	5	105
Height (in.)	10	2	42

c. about 42 in.

Examples

3. **Use scaling to solve a real-world problem.**

AL • *What ratio represents the quantities that we know?* 10 cans for AED 4

• *What are we trying to find?* the cost of 15 cans

OL • *Why do we need to scale back to 5 before scaling forward?* There is no whole number by which we can multiply 10 to get 15.

• *Why do we multiply by 3?* We are trying to reach 15 cans. Since 5 · 3 = 15, we multiply 2 by 3 also.

BL • *What is another way to solve this problem?* Sample answer: If 10 cans cost AED 4, then each can cost AED 0.40. So, 15 cans would cost AED 6.

Need Another Example?

Amani used 12 yards of fabric to make 9 blouses. Find the number of blouses she could make with 20 yards of fabric.

Yards of Fabric	12	4	20
Number of Blouses	9	3	15

15 blouses

4. **Use scaling to solve a real-world problem.**

AL • *What ratio represents the quantities that we know?* 14 hours to 8 lawns

OL • *Why do we need to scale back before scaling forward?* There is no whole number by which we can multiply 14 to get 49.

• *To what number can we scale back to? Explain.* 7; 7 is both a factor of 14 and a factor of 49.

BL • *What is the scale factor we use when we scale from 14 to 7? Explain why the scale factor is $\frac{1}{2}$.* The scale factor is $\frac{1}{2}$. Sample answer: The scale factor is the number by which you multiply. Dividing by 2 is the same as multiplying by $\frac{1}{2}$.

Need Another Example?

Zayed read 30 pages of his book in 10 minutes. If he continues at this rate, how long will it take him to read 45 pages?

Pages Read	30	15	45
Time (min)	10	5	15

15 min

Example

5. Use scaling to solve a real-world problem.

AL • *What ratio represents the quantities that we know?*
$50 for $60

• *What are we trying to find?* How much Leya would receive for $20 American

OL • *Why do we need to scale back before scaling forward?*
There is no whole number by which we can multiply 50 to get 20.

• *To what number can we scale back to? Explain.*
5; 5 is both a factor of 50 and a factor of 20.

BL • *How can you check to see if your answer is reasonable?*
Sample answer: Both ratios $\frac{\$50}{\$60}$ and $\frac{\$20}{\$24}$ simplify to $\frac{\$5}{\$6}$.

Need Another Example?
It takes a worker 70 minutes to pack 120 cartons of books. The worker has 14 minutes of work left. Use a ratio table to determine how many cartons of books the worker can pack in 14 minutes.
24 cartons

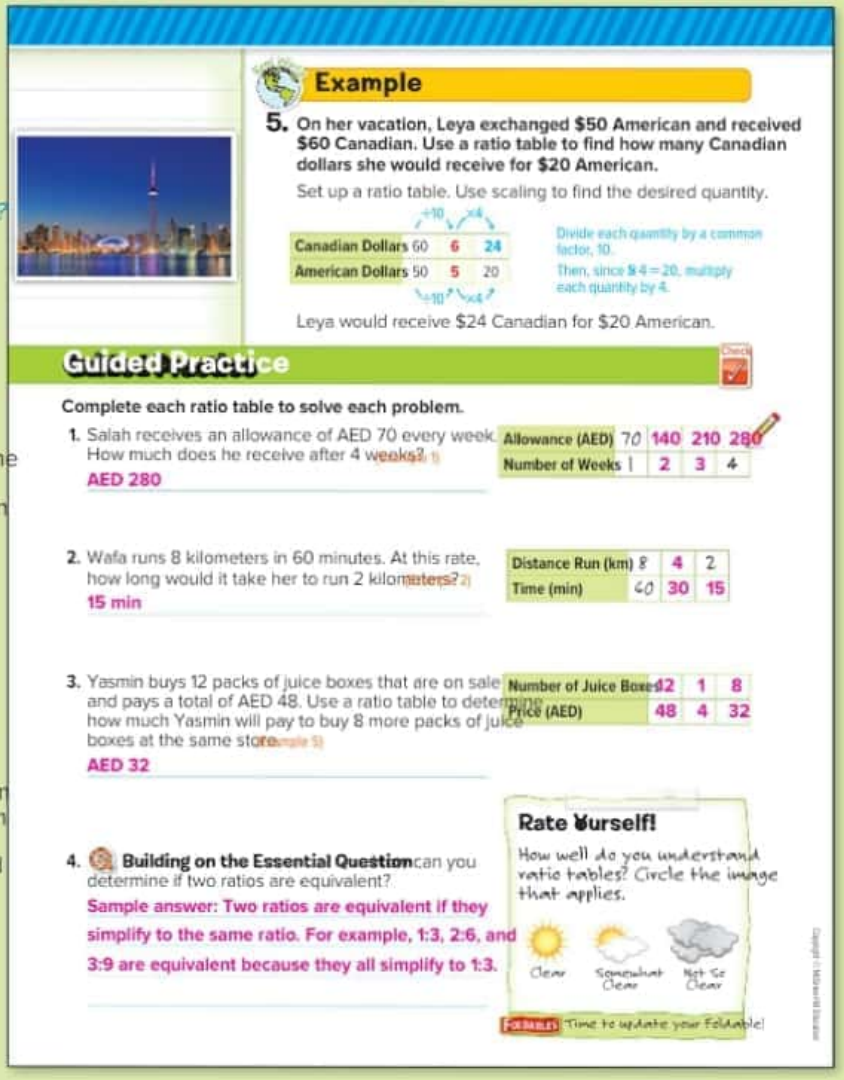
Guided Practice

Formative Assessment
Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Think-Pair-Solo** Give students a few minutes to think through their solutions to Exercises 1–4. Then have them work with a partner to complete Exercises 1 and 2. Have them work individually to complete Exercises 3 and 4. Then have them check back in with their partner to share responses and discuss and resolve any differences.

BL LA **Pairs Consult** Have students create a real-world problem in which scaling back is required before scaling forward. Then have them determine the scale factor.



Example

5. On her vacation, Leya exchanged $50 American and received $60 Canadian. Use a ratio table to find how many Canadian dollars she would receive for $20 American.

Set up a ratio table. Use scaling to find the desired quantity.

Canadian Dollars	60	6	24
American Dollars	50	5	20

(×10, ×4; ÷10, ×4)

Divide each quantity by a common factor, 10.
Then, since 5 × 4 = 20, multiply each quantity by 4.

Leya would receive $24 Canadian for $20 American.

Guided Practice

Complete each ratio table to solve each problem.

1. Salah receives an allowance of AED 70 every week. How much does he receive after 4 weeks?
AED 280

Allowance (AED)	70	140	210	280
Number of Weeks	1	2	3	4

2. Wafa runs 8 kilometers in 60 minutes. At this rate, how long would it take her to run 2 kilometers?
15 min

Distance Run (km)	8	4	2
Time (min)	60	30	15

3. Yasmin buys 12 packs of juice boxes that are on sale and pays a total of AED 48. Use a ratio table to determine how much Yasmin will pay to buy 8 more packs of juice boxes at the same store.
AED 32

Number of Juice Boxes	12	1	8
Price (AED)	48	4	32

4. **Building on the Essential Question** How can you determine if two ratios are equivalent?
Sample answer: Two ratios are equivalent if they simplify to the same ratio. For example, 1:3, 2:6, and 3:9 are equivalent because they all simplify to 1:3.

Rate Yourself!
How well do you understand ratio tables? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Complete each ratio table to solve each problem.

1. To make 5 apple pies, you need about 0.5 kilograms of apples. How many kilograms of apples do you need to make 20 apple pies? (Example 1)

Number of Pies	5	10	20
Kg of Apples	0.5	4	8

8 kilograms

2. Four balls of wool will make 8 knitted caps. How many balls of wool will Malcolm need if he wants to make 6 caps? (Examples 3 and 4)

Balls of Wool	4	1	3
Number of Caps	8	2	6

3 balls of wool

3. Before leaving to visit Mexico, Ayoub traded 270 dirhams and received 3,000 Mexican pesos. When he returned from Mexico, he had 100 pesos left. How much will he receive when he exchanges these pesos for dirhams? (Example 2)

Dirhams	270	27	9
Mexican Pesos	3,000	300	100

AED 9

4. On a bike trip across the United States, Hamdan notes that he covers about 190 miles every 4 days. If he continues at this rate, use a ratio table to determine about how many miles he could bike in 6 days. (Example 5)

Miles Biked	190	95	285
Days	4	2	6

285 mi

5. **Identify Repeated Reasoning** A punch recipe that serves 24 people calls for 4 liters of lemon-lime soda, 2 pints of sherbet, and 6 cups of ice.

People Served	24
Liters of Soda	4
Pints of Sherbet	2
Cups of Ice	6

   a. Complete a ratio table to represent this situation.

   b. How much of each ingredient would you need to make an identical recipe that serves 12 people? 36 people?

2 L soda, 1 pt sherbet, 3 c ice; 6 L soda, 3 pt sherbet, 9 c ice

   c. How much of each ingredient would you need to make an identical recipe that serves 18 people? Explain your reasoning.

3 L soda, 1.5 pt sherbet, 4.5 c ice; Sample answer: Since 18 is half of 36, half the recipe that serves 36 people will serve 18 people. 6 L ÷ 2 = 3 L, 3 pt ÷ 2 = 1.5 pt, and 9 ÷ 2 = 4.5 c.

ENGAGE EXPLORE **EXPLAIN** **ELABORATE** **EVALUATE**

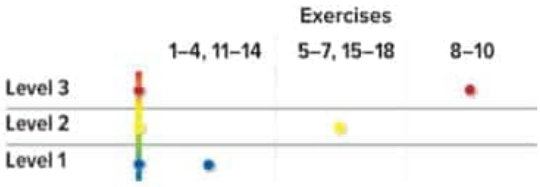
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

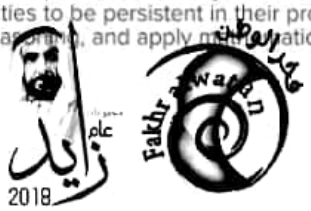
You can use the table below to select appropriate exercis your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–5, 7, 9, 10, 17, 18
OL	On Level	1–5 odd, 6, 7, 9, 10, 17, 18
BL	Beyond Level	6–10, 17, 18

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	8
3 Construct viable arguments and critique the reasoning of others.	9, 16
5 Use appropriate tools strategically.	10
7 Look for and make use of structure.	7
8 Look for and express regularity in repeated reasoning.	5

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.



Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET
Out the Door

Ask students to relate how the previous lessons on ratios and rates helped them to understand the concepts in this lesson. See students' work.

Watch Out!

Common Error Remind students that to complete some ratio tables, they may have to simplify a ratio with division before multiplying to solve for an unknown unit in the ratio.

6. On a typical day, flights at a local airport arrive at a rate of 10 every 15 minutes. At this rate, how many flights would you expect to arrive in 1 hour?
40 flights

Number of Flights	10	2	40
Minutes	15	3	60

7. MP **Identify Structure** Complete the graphic organizer to explain how equivalent ratios are used to find larger quantities and smaller quantities.

Equivalent Ratios

Larger Quantity	Smaller Quantity
See Example 1. Operation used: × Real-World Example: larger batches	See Example 2. Operation used: ÷ Real-World Example: unit rate

H.O.T. Problems Higher Order Thinking

8. MP **Find the Error** Samia used the ratio table at the right to find the number of people served with 15 kilograms of ground turkey. Find her error and correct it.
She used subtraction and addition when creating the ratio table instead of division and multiplication. Fifteen kilograms of ground turkey would feed 45 people.

Kilograms of Ground Turkey	2	1	15
People Served	6	5	19

9. MP **Justify Conclusions** There are 18 bulls and 45 cows on a ranch. If 4 more bulls and 4 more cows were added, will the ratio of bulls to cows remain the same? Justify your answer using a ratio table.
no; Sample answer: If 4 bulls and 4 cows are added, there would be 22 bulls and 49 cows on the ranch. Using the ratio table, there should be 55 cows for 22 bulls.

Bulls	18	2	22
Cows	45	5	55

10. MP **Use Math Tools** Complete the ratio table to illustrate a real-world relationship among two quantities in which the scale factor is 6. See students' work.

Name _____ My Homework _____

Extra Practice

Complete each ratio table to solve each problem.

11. A zoo requires that 1 adult accompany every 7 students that visit the zo. How many adults must accompany 28 students?

Number of Adults	1	2	3	4
Number of Students	7	14	21	28

12. Hind purchased 200 beads for AED 48 to make necklaces. If she needs to buy 25 more beads, how much will she pay if she is charged the same rate?

Number of Beads	200	100	25
Cost in Dirhams	48	24	6

AED 6

13. If a hummingbird were to get all of its food from a feeder, then a 16-ounce nectar feeder could feed about 80 hummingbirds a day. How many hummingbirds would you expect to be able to feed with a 12-ounce feeder?

Ounces of Nectar	16	2	12
Number of Birds Fed	80	10	60

60 birds

14. When a photo is reduced or enlarged, its length to width ratio usually remains the same. Aida wants to enlarge a 4 in. by 6 in. photo so that it has a width of 15 in. Use a ratio table to determine the new length of the photo.

Length (in.)	4	2	10
Width (in.)	6	3	15

10 in.

15. Sami owns a hybrid SUV that can travel 400 kilometers on a 15 liters tank of petrol. Determine how many kilometers he can travel on 6 liters.

160 km

16. **Justify Conclusions** A veterinarian needs to know an animal's weight in kilograms. If 20 pounds is about 9 kilograms and a dog weighs 30 pounds, use a ratio table to find the dog's weight in kilograms. Explain your reasoning.

Pounds	20	60	30
Kilograms	9	27	13.5

If 20 lb = 9 kg, then 60 lb is about 27 kg. Since half of 60 is 30, a 30 lb dog weighs half of 27 kg or 27which is 13.5 kg.

Power Up! Test Practice

Exercises 17 and 18 prepare students for more rigorous thinking needed.

17.

This test item requires students to reason abstractly and quantitatively when problem solving.	
Depth of Knowledge	DOK2
Mathematical Practices	MP1, MP4
Scoring Rubric	
1 point	Student must write 7.5 for credit.

18.

This test item requires students to reason abstractly and quantitatively when problem solving.	
Depth of Knowledge	DOK1
Mathematical Practices	MP2, MP7
Scoring Rubric	
1 point	Students correctly answer each part of the question.

Power Up! Test Practice

17. Hana is making biscuits using the recipe.

How many cups of flour will he need to make 30 biscuits? 7.5 c

Whole Wheat Biscuits

2 c	Whole wheat flour
4 tsp	Baking powder
1 tsp	Salt
2 tbsp	Shortening
1 c	Milk
1	Small egg

Makes 8 biscuits

18. Reham walked 3 blocks in 15 minutes. Based on this rate, determine if each statement is true or false.

a. Reham walks 9 blocks in 45 minutes. True False

b. Reham walks 4 blocks in 25 minutes. True False

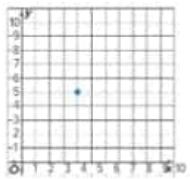
c. Reham walks 8 blocks in 40 minutes. True False

d. Reham walks 12 blocks in 60 minutes. True False

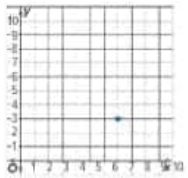
Spiral Review

Identify each point shown on the graph.

19. (4 , 5)



20. (7 , 3)



21. Khmees is drawing a map. He needs to plot four points to identify four places on his map. Plot and label the following points.

a. the library at (3, 2)

b. the school at (6, 4)

c. the park at (8, 1)

d. Khmees's house at (2, 8)

Lesson 5

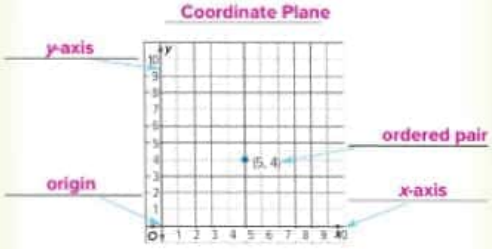
Graph Ratio Tables

Vocabulary Start-Up

The **coordinate plane** is formed when two perpendicular number lines intersect at their zero points. This point is called the **origin**. The horizontal number line is called the **x-axis** and the vertical number line is called the **y-axis**. An **ordered pair**, such as (2, 3), is a pair of numbers used to locate a point on the coordinate plane.

Fill in the blanks with the hightlighted words from above.

Coordinate Plane



Essential Question

HOW do you use equivalent rates in the real world?

Vocabulary

coordinate plane
origin
x-axis
y-axis
ordered pair
x-coordinate
y-coordinate
graph

Mathematical Practices
1, 3, 4

Real-World Link

In 3 minutes, a North American wood turtle can travel about 17 cm. The *x*-axis represents minutes and the *y*-axis represents cm, write an ordered pair to represent this situation.

(3 , 17)
minutes cm

Which Mathematical Practices do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Use graphs to represent problems involving ratio and rates.

Coherence connecting within and across grades

Previous	Now	Next
Students represented problems involving ratios and rates with tables.	Students create graphs from ratio tables.	Students will find equivalent ratios and rates.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 51.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Pairs Discussion** Have students work with a partner to label the coordinate plane. Have them t of other words or phrases they can use to help remembe each vocabulary te MP 1, 5, 6

Alternate Strategies

AL LA Provide students with a word bank of terms if the are having difficulty labeling the coordinate plane. MP 1, 6

BL LA Have the students investigate the origin of the Cartesian coordinate system and the French mathematici Rene Descartes. Have them prepare a brief oral presenta for the class. MP 1, 3

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Graph ordered pairs from a table.

AL • *Which coordinate do we locate first?* x-coordinate

OL • *To begin locating the point (1, 3), how far along the x-axis, and in which direction, do we move from the origin?* to the right 1 unit

BL • *How would the location of the point (1, 3) be different from the location of the point (3, 1)?* (1, 3) is located 1 unit to the right of the origin and 3 units up. (3, 1) is located 3 units to the right of the origin and 1 unit up.

2. Describe the pattern in the graph.

AL • *How can you tell that the points appear to fall in a line?* Sample answer: Connect the points.

OL • *What is the pattern in the graph?* Each point is located one unit to the right and three units up from the previous point.

• *What does this pattern mean in the context of the problem?* The cost increases by AED 3 for every CD.

BL • *If the pattern continued, what would be the next two points?* (4, 12) and (5, 15)

Need Another Example?

The table shows the distance Kaylee travels on her scooter. The table also shows this information as ordered pairs (time in seconds, distance in feet). Graph the ordered pairs. Then interpret the pattern in the graph. See Answer Appendix.

Distance on Scooter		
Time, x	Distance, y	Ordered Pair (x, y)
1	4	(1, 4)
2	8	(2, 8)
3	12	(3, 12)
4	16	(4, 16)

Work Zone

Graph Ordered Pairs

You can use an ordered pair to name any point on the coordinate plane. The first number in an ordered pair is the x-coordinate and the second number is the y-coordinate.

The x-coordinate corresponds to a number on the x-axis. → (3, 6) ← The y-coordinate corresponds to a number on the y-axis.

You can express information in a table as a set of ordered pairs. To see patterns, graph the ordered pairs on the coordinate plane.

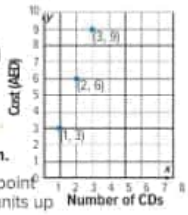
Examples

The table shows the cost in dirhams to create CDs of digital photos at a photo shop. The table also shows this information as ordered pairs (number of CDs, cost in AED).

Cost to Create CDs		
Number of CDs, x	Cost in AED, y	Ordered Pair (x, y)
1	3	(1, 3)
2	6	(2, 6)
3	9	(3, 9)

1. Graph the ordered pairs.

Start at the origin. Use the x-coordinate and move along the x-axis. Then use the y-coordinate and move along the y-axis. Draw a dot at each point.



2. Describe the pattern in the graph.

The points appear in a line. Each point is one unit to the right and three units up from the previous point.

So, the cost increases by AED 3 for every CD created.

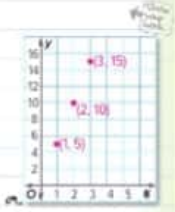
Got it? Do these problems to find out.

The table shows Nabila's earnings for 1, 2, and 3 hours. The table also lists this information as ordered pairs (hours, earnings).

Nabila's Earnings		
Hours, x	AED Earned, y	Ordered Pair (x, y)
1	5	(1, 5)
2	10	(2, 10)
3	15	(3, 15)

a. Graph the ordered pairs.

b. Describe the pattern in the graph.



b. The graph shows that Nabila's earnings increase by AED 5 each hour.

Ratios and Proportional Relationships

Compare Ratios

You can use tables and graphs to compare ratios. The greater the ratio, the steeper the line will appear.

Examples

Two friends are making scrapbooks. Shamma places 4 photos on each page of her scrapbook. Ghaya places 6 photos on each page of her scrapbook.

3. **Make a table for each scrapbook that shows the total number of photos placed, if each book has 1, 2, 3, or 4 pages. List the information as ordered pairs (pages, photos).**

Shamma's Scrapbook		
Pages, x	Photos, y	(x, y)
1	4	(1, 4)
2	8	(2, 8)
3	12	(3, 12)
4	16	(4, 16)

Ghaya's Scrapbook		
Pages, x	Photos, y	(x, y)
1	6	(1, 6)
2	12	(2, 12)
3	18	(3, 18)
4	24	(4, 24)

Stop and Reflect

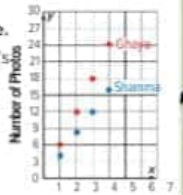
Hamad is also making a scrapbook. She places 5 photos on each page. How does the ratio of photos to each page compare for her book, Ghaya's book, and Shamma's book?

The ratio of photos to pages for Ghaya's book is 6:1. On a graph, the line would appear steeper for Ghaya, but less steep for Shamma.

4. **Graph the ordered pairs for each friend on the same coordinate plane.**

Graph the ordered pairs for Shamma's scrapbook in blue.

Graph the ordered pairs for Ghaya's scrapbook in red.



5. **How does the ratio of photos to each page compare for each person? How is this shown on the graph?**

The ratio of photos to pages for Ghaya's scrapbook is 6:1 while the ratio for Shamma's scrapbook is 4:1. On the graph, both sets of points appear to be in a straight line, but the line for Ghaya is steeper than the line for Shamma.

Examples

3–5. **Create a table and a graph to compare ratios.**

AL
- *How many total photos will Shama have on one page?* 4 *two pages?* 8 *three pages?* 12 *four pages?* 16
- *How many total photos will Ghaya have on one page?* 6 *two pages?* 12 *three pages?* 18 *four pages?* 24

OL
- *What are the ordered pairs for Shama? Ghaya?* (1, 4), (2, 8), (3, 12), (4, 16); Ghaya: (1, 6), (2, 12), (3, 18), (4,
- *In the graph, what do the blue points represent?* Shama's scrapbook
- *What do the red points represent?* Ghaya's scrapbook
- *How can you use the table or graph to predict the number of photos that each friend will use on 15 pages?* Sample answer: Extend the pattern in the table the graph. Shama uses 4 times as many photos as page she will use 15 · 4, or 60 photos. Ghaya uses 6 times as many photos as pages, so she will use 6 · 15, or 90 photos.

BL
- *Study the graph. As the number of pages increases what happens to the vertical distance between Shama's and Ghaya's graphs? What does this mea the context of the problem?* The points for Ghaya's scrapbook become farther and farther apart from Sham scrapbook. This is because Ghaya uses 2 more photos p page than Shama. As the number of pages increase, Gh will use more and more photos than Shama.

Need Another Example?

SnapShot is a digital photo service that charges 20 fils pe photo. MyPics charges 12 fils per photo. Make a table for service that shows the cost for 1, 2, 3, and 4 photos. List t information as ordered pairs (photos, cost). Then graph th ordered pairs for each service on the same coordinate pla How do the ratios of cost per photo for each service compare? See Answer Appendix.

Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Roundrobin** Have students work in groups of 3 or 4 to complete Exercises 1–4. Have Student 1 read the exercise aloud. Student 2 completes the first few steps of the exercise. For example, in Exercise 1, Student 2 could complete the first column of each table. Student 3 completes the rest of the exercise. Then Student 4, if available, agrees or disagrees with the final solution. If there is any disagreement, Student 4 explains how the solution should be changed. Students trade roles for each successive exercise. MP 1, 3

BL LA **Gallery Walk** Have students work with a partner to create a real-world problem similar to the one posed in Exercises 1–4. Post the problems around the room. Students walk around the room and select a problem, not their own. Working with their partner, they create a table and a graph and determine the solution. Have them locate the pair of students who wrote the problem to have them check their work. MP 1, 3, 4, 5

Watch Out!

Common Error Remind students that the order in which the coordinates are listed is important. Students will still graph a straight line if the ordered-pair values are transposed, but that line will be an incorrect line. Encourage students to "run" along the x-axis and then "rise" to the y-value.

Guided Practice

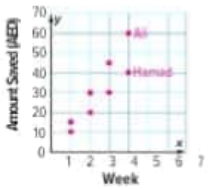
Two friends are each saving money in their bank accounts. Hamad saves AED 10 each week while Ali saves AED 15 each week.

1. Make a table for each friend that shows the total amount saved for 1, 2, 3, and 4 weeks. List the information as ordered pairs (weeks, total dirhams saved).

Hamad		
Weeks, x	Total Saved (AED), y	(x, y)
1	10	(1, 10)
2	20	(2, 20)
3	30	(3, 30)
4	40	(4, 40)

Ali		
Weeks, x	Total Saved (AED), y	(x, y)
1	15	(1, 15)
2	30	(2, 30)
3	45	(3, 45)
4	60	(4, 60)

2. Graph the ordered pairs for each friend on the same coordinate plane.



3. How do the ratios of Hamad's savings and Ali's savings compare? How is this shown on the graph?

Sample answer: Ali's savings, AED 15 per week, increases at a higher rate than Hamad's savings, AED 10 per week. Both sets of points appear as straight lines. Ali's savings is shown on the graph as a steeper line.

4. **Building on the Essential Question** How can graphing help solve a problem involving ratios?

Sample answer: A graph shows which ratio is greater when comparing 2 ratios.

Rate Yourself!

How confident are you about graphing ratios? Check the box that applies.

FOLDABLES Time to update your Foldable!

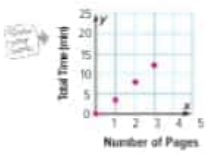
Name _____ My Homework _____

Independent Practice

The table shows the total time it took Samir to read 0, 1, 2, and 3 pages of the book. The table also lists this information as ordered pairs (number of pages, total minutes). 1–2

Samir's Reading		
Number of Pages, x	Total Minutes, y	Ordered Pair (x, y)
0	0	(0, 0)
1	4	(1, 4)
2	8	(2, 8)
3	12	(3, 12)

1. Graph the ordered pairs.



2. Describe the pattern in the graph.

The graph shows that Samir read 1 page every 4 minutes.

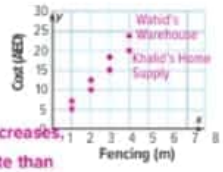
Khalid's Home Supply charges AED 5 for each meter of fencing. Wahid's Warehouse charges AED 6 for each meter of fencing. 2–5

3. Make a table for each store that shows the total cost for 1, 2, 3, or 4 meter of fencing. List the information as ordered pairs (meter of fencing, total cost).

Khalid's Home Supply		
Fencing (m), x	Cost (AED), y	(x, y)
1	5	(1, 5)
2	10	(2, 10)
3	15	(3, 15)
4	20	(4, 20)

Wahid's Warehouse		
Fencing (m), x	Cost (AED), y	(x, y)
1	6	(1, 6)
2	12	(2, 12)
3	18	(3, 18)
4	24	(4, 24)

4. Graph the ordered pairs for each store on the same coordinate plane.



5. Using the tables and graphs, write a few sentences comparing the ratios of amount charged per meter of fencing for each store. How is this shown on the graph?

Sample answer: As the number of meters of fencing increases, the cost at Wahid's Warehouse increases at a faster rate than the cost at Khalid's Home Supply. The cost at Wahid's Warehouse is shown on the graph as a steeper line.

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

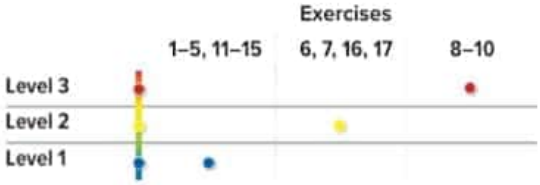
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–5, 7, 10, 16, 17
OL	On Level	1–5 odd, 6, 7, 10, 16, 17
BL	Beyond Level	6–10, 16, 17

MATHEMATICAL PRACTICES	
Emphasis On	**Exercise(s)**
1 Make sense of problems and persevere in solving them.	9, 10
3 Construct viable arguments and critique the reasoning of others.	6, 15
4 Model with mathematics.	7, 8

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET
Out the Door

Ask students to create a coordinate plane with the ordered pairs (1, 9), (2, 18), and (3, 27). Ask them to find the missing value in (6, ?) if the pattern continues. 54

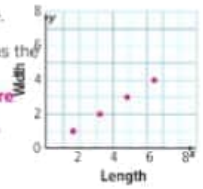
6. **Justify Conclusions** Patty's Pies made 2 peach pies using 10 cups of peaches. They made 3 pies using 15 cups of peaches and 4 pies using 20 cups of peaches. Predict how many cups of peaches would be needed to make 9 peach pies. Explain. 45 cups; The ratios $\frac{2}{10}$, $\frac{3}{15}$, $\frac{4}{20}$ show the number of pies to cups of peaches. $\frac{2}{10} = \frac{3}{15} = \frac{4}{20} = \frac{1}{5}$. The ratio $\frac{9}{45}$ is also equivalent to $\frac{1}{5}$. The ratio $\frac{9}{45}$ means that 45 cups of peaches will be needed to make 9 pies.

7. **Multiple Representations** A *golden rectangle* is a rectangle in which the ratio of the length to the width is approximately 1.618 to 1. This ratio is called the *golden ratio*.

Length, x	Width, y	(x, y)
1.618	1	(1.618, 1)
3.236	2	(3.236, 2)
4.854	3	(4.854, 3)
6.472	4	(6.472, 4)

a. **Table** Make a ratio table to show the approximate lengths of golden rectangles given widths that are 1, 2, 3, and 4 units. List the information as ordered pairs (length, width).

b. **Graph** Graph the ordered pairs on the coordinate plane.



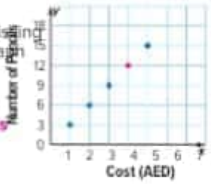
c. **Analyze** How does the area of each rectangle change as the dimensions change?
The area of the first rectangle in the table is 1.618 square units. The areas increase to 6.472, 14.562, and 25.888.

H.O.T. Problems Higher Order Thinking

8. **Model with Mathematics** Create a real-world problem using ratios or rates that could be represented on the coordinate plane. Sample answer: Seham earns AED 50 an hour tutoring. Make a table showing the relationship between the number of hours she tutors and the amount of money she earns.

9. **Persevere with Problems** Name the coordinates of the point located halfway between (2, 1) and (2, 25). (2, 13)

10. **Persevere with Problems** The graph shows the cost of purchasing pencils from the school office. The graph is missing a point to indicate the cost of 12 pencils. Complete the graph by plotting the missing information. Explain your answer.
Sample answer: The points at (1, 3), (2, 6), (3, 9), and (5, 15) represent a rate equivalent to 1:3. The rate 4:12 is equivalent to 1:3. So, the cost of 12 pencils is AED4.

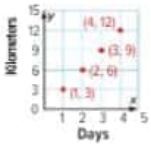


Name _____ My Homework _____

Extra Practice

The table shows the total number of kilometers Amna runs for several days. The table also lists this information as ordered pairs (number of days, total kilometers).

11. Graph the ordered pairs.



Amna's Running Record		
Days, x	Kilometers, y	(x, y)
1	3	(1, 3)
2	6	(2, 6)
3	9	(3, 9)
4	12	(4, 12)

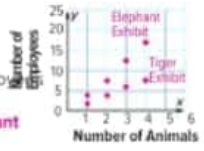
12. Describe the pattern in the graph. The graph shows that as the number of days increases by 1, the number of kilometers run increases by 3.

There are two employees for every tiger in the tiger exhibit at a local zoo. For every elephant in the elephant exhibit, there are four employees.

13. Make a table for each animal that shows the total number of employees for 1, 2, 3, or 4 animals. List the information as ordered pairs (number of animals, number of employees).

Tiger Exhibit			Elephant Exhibit		
Animals, x	Employees, y	(x, y)	Animals, x	Employees, y	(x, y)
1	2	(1, 2)	1	4	(1, 4)
2	4	(2, 4)	2	8	(2, 8)
3	6	(3, 6)	3	12	(3, 12)
4	8	(4, 8)	4	16	(4, 16)

14. Graph the ordered pairs for each exhibit on the same coordinate plane.



15. **Justify Conclusions** Using the tables and graphs, write a few sentences comparing the ratios of the number of employees per animal. How is this shown on the graph?

Sample answer: The number of employees for the elephant exhibit increases at a faster rate than the number of employees for the tiger exhibit. The line representing the elephant exhibit is a steeper line.

Power Up! Test Practice

Exercises 16 and 17 prepare students for more rigorous thinking needed.

16.

This test item requires students to reason abstractly and quantitatively when problem solving.	
Depth of Knowledge	DOK1
Mathematical Practices	MP4, MP6
Scoring Rubric	
1 point	The student selects the choice for more students per teacher at Hamilton Middle School.

17.

This test item requires students to support their reasoning or evaluate the reasoning of others by justifying their response and constructing arguments.	
Depth of Knowledge	DOK3
Mathematical Practices	MP2, MP3, MP4
Scoring Rubric	
2 points	Student states that Nina will need to mow 8 lawns and explains why she will need to mow 8 lawns instead of another number of lawns.
1 point	Student states that Nina will need to mow 8 lawns.

Power Up! Test Practice

16. The table gives the ratio of teachers to students at a Dubai Middle School.

Dubai Middle School	
Students, x	Teachers, y
24	1
48	2
72	3
96	4

At a Sharjah Middle School, the ratio of teachers to students is 12 to 312. Which statement correctly compares the ratio of the teachers to students at the two schools?

- ■ There are more students per teacher at the Sharjah Middle School than at the Dubai Middle School.
- ☐ Both schools have an equivalent ratio of students to teachers.
- ☐ There are more students at the Sharjah Middle School than at the Dubai Middle School.
- ☐ There are more students per teacher at the Dubai Middle School than at the Sharjah Middle School.

17. Nina earns AED 15 for each lawn she mows. She wants to buy a dress that costs AED 109. How many lawns will she need to mow to earn the money for the dress? Explain.

She needs to mow 8 lawns. She'll earn AED 120 from mowing 8 lawns. This is more than she needs, but if she mowed only 7 lawns she would get AED 105 and that wouldn't be enough.

Spiral Review

Simplify each fraction.

18. $\frac{13}{78} = \frac{1}{6}$

19. $\frac{26}{130} = \frac{1}{5}$

20. $\frac{20}{240} = \frac{1}{12}$

21. There are 270 Grade 6 students and 45 adults going on a field trip. How many students will be with each adult if the groups are divided equally?

6 students

22. Several students were surveyed about their favorite class. The results are shown in the table. What fraction of the students chose music as their favorite subject? Write the fraction in simplest form.

8/57

Favorite Class	
Art	26
English	19
Math	21
Music	16
Science	32

Ratios and Proportional Relationships

MP Problem-Solving Investigation

The Four-Step Plan

MP Mathematical Practices 1, 3, 4

Case #1 Cabin Fever

At a summer camp, the ratio of cabins to campers is 15 to 180. An equal number of campers are staying in each cabin.

How many campers are in each cabin?

1 Understand *What are the facts?*

- You know there are 15 cabins for 180 campers.
- You need to find how many campers are in each cabin.

2 Plan *What is your strategy to solve this problem?*

Divide 180 by 15. Before you calculate, estimate.

Estimate 200 ÷ 20 = 10

3 Solve *How can you apply the strategy?*

Use long division to find the number of campers in each cabin.

$$\begin{array}{r} 12 \\ 15\overline{)180} \\ -\,15 \\ \hline 30 \\ -30 \\ \hline 0 \end{array}$$

There are 12 campers in each cabin.

4 Check *Does the answer make sense?*

Check by multiplying. Since 15 × 12 = 180, the answer is correct.

Analyze the Strategy

MP **Justify Conclusions** How many campers would be in each cabin if the ratio of cabins to campers was 15 to 225? Explain.

15 campers; Sample answer: Use long division to find the answer.

225 ÷ 15 = 15

Focus narrowing the scope

Objective Solve problems by using the four-step plan. This lesson emphasizes MP **Mathematical Practice 3** Construct viable arguments and critique the reasoning of others.

The Four Step Plan Problems can often be solved by using different strategies. Sometimes they can be solved more with one strategy than another.

Coherence connecting within and across grades

Now Students solve non-routine problems.

Next Students will apply the Four-Step Plan to solve real-world problems.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 57.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

The problems on pages 55 and 56 are intended to be use a whole-group discussion on how to solve non-routine problems and are designed to provide scaffolded guidanc The problem on page 55 walks students through the solu while the problem on page 56 asks students to come up their own solutions.

Case #1 Cabin Fever

AL Have students answer the question MP low.

Ask:

- *Would all 15 cabins have the same number of campers ratio was 15 to 200? Explain your reasoning.* Sample answer: Because 200 cannot be evenly divided by 15, there not be the same number of campers in every cabin.

Case #2 Show Me the Money

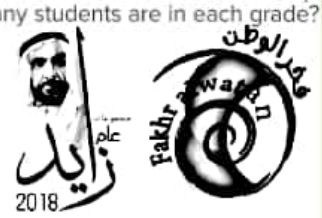
AL LA **Roundrobin** Have students work in pairs to share the steps of four-step plan and their strategy for each step. One student explains and shares how they completed the first step, Understand. The second student explains and shares how they completed the second step, Plan. Then the first student explains and shares how they completed the third step, Solve. The second student explains and shares how they completed the last step, Check. MP 3, 5

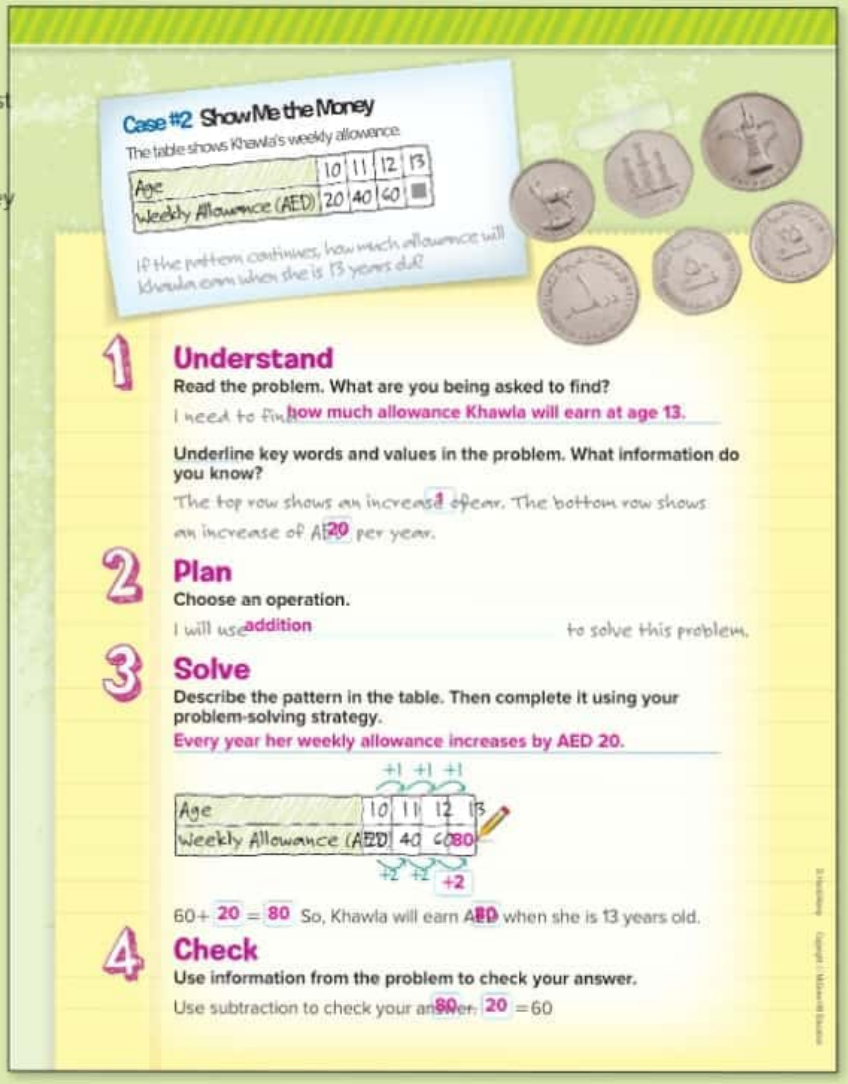
BL LA **Trade-a-Problem** Have students create their own problem, similar to Case #2. Students trade their problems, solve each other's problem, and compare solutions. If the solutions do not agree, students work together to find the errors. MP 1, 3, 4

Need Another Example?

Pine Street Middle School has 360 students divided equally into four grades. How many students are in each grade?

90 students





2 Collaborate

Work with a small group to solve the following cases.
Show your work on a separate piece of paper.

Case #3 Walking

Maha uses a pedometer to find how many steps she takes each school day. She took 32,410 steps over the course of 5 days. She took the same number of steps each day and each step is 28 inches.

How many miles did she walk on Monday? Round to the nearest hundredth. (Hint: There are 5280 feet in one mile.)

2.86 mi

Case #4 Savings

Ayman is earning money to buy a AED 100 bicycle. For each dirham Ayman earns, his mother has agreed to give him 1 dirham. So far, he has earned AED 14 mowing lawns and AED 7 washing cars.

How much more must Ayman earn in order to buy the bicycle?

AED 29

Case #5 Money

Mrs. Zahra is buying a new big-screen television. She made an initial payment of AED 50 and paid a total of AED 890 over 12 months.

How much did she pay each month?

AED 70

Case #6 Sports Equipment

Mrs. Dimas has AED 130 to buy basketballs for Fujairah Middle School.

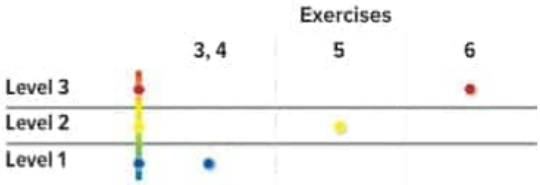
How many can she buy at AED 15 each? Interpret the remainder.

8 basketballs; The remainder is 10, so she will have AED 10 left.

Use any strategy!

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level 1 indicating the lowest level of complexity.



AL LA Think-Pair-Share Have students work in pairs. Give students one minute to think through their responses Cases 3–6. Have them share with their partner. Then disc the following within a large gr MP 3

Ask:

- *Did each pair use the same strategy to solve Cases 3–*
  Sample answer: no
- *What can you conclude about solving a word problem the four-step pla*
  Sample answer: There are different ways t solve a word problem. You can use the four-step plan to com with the right strategy.

BL LA Pairs Discussion Have students work in pairs to discuss how they solved Cases 3–6. Then call on one stu to share their responses within a small group or large gro discussion MP 1, 3

Mid-Chapter Check

If students have trouble with Exercises 1–8, they may need help with the following concepts.

Concept	Exercise(s)
ratios (Lessons 2 and 4)	1, 5, 8
greatest common factor (Lesson 1)	2, 4
least common multiple (Lesson 1)	3
unit rates (Lesson 3)	6
graphs of ordered pairs (Lesson 5)	7

Vocabulary Activity

LA Numbered Heads Together Have students work in a small group to complete Exercise 1. Each student is assigned a number. Students are responsible to ensure that each group member understands the definition of a ratio. Students should ask each other for clarification and assistance, as needed. Call on one numbered student to share their responses with the class. **MP 3, 6**

Alternate Strategy

AL Have students create several examples of ratios.

Mid-Chapter Check

Vocabulary Check

1. Fill in the blank in the sentence below with the correct term.
A ratio is a comparison of two quantities by division.

Skills Check and Problem Solving

Find the greatest common factor or least common multiple of each set of numbers. (Lesson 1)

2. 24 and 18
GCF= 6

3. 12 and 20
LCM= 60

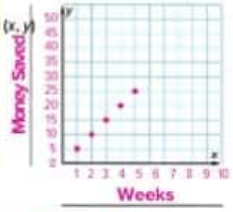
4. 16 and 32
GCF= 16

5. Write *5 cookies to 40 brownies* as a ratio in simplest form. (Lesson 2) 3:8

6. Write 171 km in 3 hours as a unit rate. (Lesson 3) $\frac{57 \text{ km}}{1 \text{ h}}$

7. **MP Use Math Tools** The table below shows the amount in Khaled's account each week. List the information as ordered pairs and then graph the ordered pairs. Describe the pattern in the graph. (Lesson 5)

Khaled's Savings		
Week, x	Savings (AED), y	Ordered Pair (x, y)
1	5	(1, 5)
2	10	(2, 10)
3	15	(3, 15)
4	20	(4, 20)
5	25	(5, 25)



The graph shows that Khaled saved AED 5 each week.

8. **MP Persevere with Problems** An artist is using three different colors in a mosaic. The ratio of green to blue to yellow color tiles in the mosaic is 4:6:9. She has 42 blue tiles to use. How many green and yellow tiles does she need?

28 green tiles and 63 yellow tiles

Lesson 6

Equivalent Ratios

Real-World Link

Photography Amal spent AED 20 to make 10 prints from a photo booth. Later, she spent AED 60 to make 30 prints.

Number of Prints	Cost (AED)
10	20
30	60

Essential Question

HOW do you use equivalent rates in the real world?

Mathematical Practices

1, 3, 4, 6, 7

1. Express the relationship between the number of prints she made and the total cost for each situation as a rate in fraction form.

   10 prints / AED 20 and 30 prints / AED 60

2. Compare the relationship between the numerators of each rate in Exercise 1. Compare the relationship between the denominators of these rates.

   Sample answer: The numerator in the second rate is 3 times the numerator in the first rate. The denominator in the second rate is 3 times the denominator in the first rate.

3. What is the unit rate for 10 prints? $\frac{10 \text{ prints}}{\text{AED } 20} \div \frac{2}{2} = \frac{5 \text{ prints}}{\text{AED } 10}$

4. What is the unit rate for 30 prints? $\frac{30 \text{ prints}}{\text{AED } 60} \div \frac{6}{6} = \frac{5 \text{ prints}}{\text{AED } 10}$

5. Are the rates in Exercise 1 equivalent? Explain.

   Yes; Sample answer: They have the same unit rate of 5 prints for AED 10.

Which **Mathematical Practices** do you use? Shade the circle(s) that applies.

- ① Persevere with Problems
- ② Reason Abstractly
- ③ Construct an Argument
- ④ Model with Mathematics
- ⑤ Use Math Tools
- ⑥ Attend to Precision
- ⑦ Make Use of Structure
- ⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Find equivalent ratios and rates by using unit rate and equivalent fractions.

Coherence connecting within and across grades

Previous Students represented real-world problems involving ratios with tables and graphs.

Now Students find and use equivalent ratios and rates to solve problems.

Next Students will model ratio and rate problems.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 63.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA Think-Pair-Sold ave students work in pairs to complete Exercises 1 and 2. Then have them individually complete Exercises 3–5. Upon completion, ha them share their responses with their partner to discuss a resolve any differenc MP 1, 3

Alternate Strategies

AL Have students work backward in the table to find the cost for 1 print. Have them compare this to the answer the found for Exercise MP 1, 3, 5

BL Have students extend the problem by asking how mu 60, 80, and 100 prints would cost if this pattern continued MP 1, 8

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Use unit rates to determine equivalent rates.

AL • *How can you write 20 miles in 5 hours as a fraction? 45 miles in 9 hours?* $\frac{20 \text{ miles}}{5 \text{ hours}}$; $\frac{45 \text{ miles}}{9 \text{ hours}}$

OL • *What is the unit rate for each?* $\frac{4 \text{ miles}}{1 \text{ hour}}$; $\frac{5 \text{ miles}}{1 \text{ hour}}$

• *Are the rates equivalent? Explain.* No; The rates do not have the same unit rate.

BL • *How could you adjust one of the rates so that the pair of rates would be equivalent?* Sample answer: The second rate could be 36 miles in 9 hours.

Need Another Example?

Determine if the rates 20 rolls for AED 5 and 48 rolls for AED 12 are equivalent. Explain your reasoning. Since the rates are the same, $\frac{4 \text{ rolls}}{\text{AED } 1}$, the rates are equivalent. $\frac{20 \text{ rolls}}{\text{AED } 5} = \frac{48 \text{ rolls}}{\text{AED } 12}$

2. Use unit rates to determine equivalent rates.

AL • *How can you write AED 21 for 3 T-shirts as a fraction? AED 35 for 5 T-shirts?* $\frac{\text{AED } 21}{3 \text{ T-shirts}}$; $\frac{\text{AED } 35}{5 \text{ T-shirts}}$

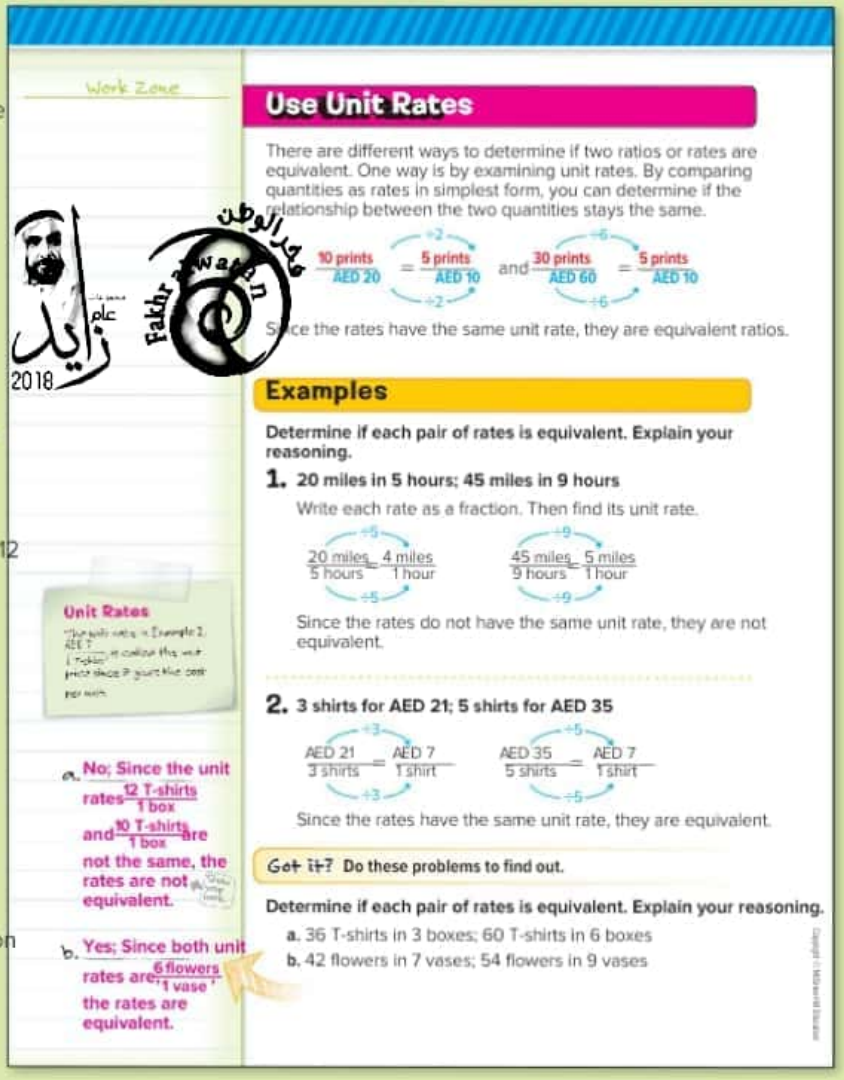
OL • *What is the unit rate for each?* $\frac{\text{AED } 7}{1 \text{ T-shirt}}$; $\frac{\text{AED } 7}{1 \text{ T-shirt}}$

• *Are the rates equivalent? Explain.* Yes; The rates have the same unit rate.

BL • *At this rate, what would be the cost for 7 T-shirts?* AED 49

Need Another Example?

Determine if the rates 42 people on 7 teams and 64 people on 8 teams are equivalent. Explain your reasoning. Since the unit rates, $\frac{6 \text{ people}}{1 \text{ team}}$ and $\frac{8 \text{ people}}{1 \text{ team}}$, are not the same, the rates are not equivalent.



Work Zone

Use Unit Rates

There are different ways to determine if two ratios or rates are equivalent. One way is by examining unit rates. By comparing quantities as rates in simplest form, you can determine if the relationship between the two quantities stays the same.

$\frac{10 \text{ prints}}{\text{AED } 20} \overset{\times 2}{=} \frac{5 \text{ prints}}{\text{AED } 10}$ and $\frac{30 \text{ prints}}{\text{AED } 60} \overset{\times 6}{=} \frac{5 \text{ prints}}{\text{AED } 10}$

Since the rates have the same unit rate, they are equivalent ratios.

Examples

Determine if each pair of rates is equivalent. Explain your reasoning.

1. 20 miles in 5 hours; 45 miles in 9 hours

Write each rate as a fraction. Then find its unit rate.

$\frac{20 \text{ miles}}{5 \text{ hours}} \overset{\div 5}{=} \frac{4 \text{ miles}}{1 \text{ hour}}$ $\quad \frac{45 \text{ miles}}{9 \text{ hours}} \overset{\div 9}{=} \frac{5 \text{ miles}}{1 \text{ hour}}$

Since the rates do not have the same unit rate, they are not equivalent.

2. 3 shirts for AED 21; 5 shirts for AED 35

$\frac{\text{AED } 21}{3 \text{ shirts}} \overset{\div 3}{=} \frac{\text{AED } 7}{1 \text{ shirt}}$ $\quad \frac{\text{AED } 35}{5 \text{ shirts}} \overset{\div 5}{=} \frac{\text{AED } 7}{1 \text{ shirt}}$

Since the rates have the same unit rate, they are equivalent.

Got it? Do these problems to find out.

Determine if each pair of rates is equivalent. Explain your reasoning.

a. 36 T-shirts in 3 boxes; 60 T-shirts in 6 boxes

b. 42 flowers in 7 vases; 54 flowers in 9 vases

Unit Rates

a. No; Since the unit rates $\frac{12 \text{ T-shirts}}{1 \text{ box}}$ and $\frac{10 \text{ T-shirts}}{1 \text{ box}}$ are not the same, the rates are not equivalent.

b. Yes; Since both unit rates are $\frac{6 \text{ flowers}}{1 \text{ vase}}$, the rates are equivalent.

Example

3. **Fatima read the first 60 pages of a book in 3 days. She read the last 90 pages in 6 days. Are these reading rates equivalent? Explain your reasoning.**

$\frac{60 \text{ pages}}{3 \text{ days}} = \frac{20 \text{ pages}}{1 \text{ day}}$ (×3) $\qquad \frac{90 \text{ pages}}{6 \text{ days}} = \frac{15 \text{ pages}}{1 \text{ day}}$ (×6)

Since the rates do not have the same unit rate, they are not equivalent. So, Fatima's reading rates are not equivalent.

Got it? **Do these problems to find out.**

c. Maysa made 10 bracelets for 5 friends. Laila made 12 bracelets for 4 friends. Are these rates equivalent? Explain your reasoning.

d. Club A raised AED 1680 by washing 42 cars, and Club B raised AED 1520 by washing 38 cars. Are these rates equivalent? Explain your reasoning.

Proportion

A proportion is an equation stating that two ratios or rates are equivalent.

c. No; Since the unit rates, $\frac{2 \text{ bracelets}}{1 \text{ friend}}$ and $\frac{3 \text{ bracelets}}{1 \text{ friend}}$, are not the same, the rates are not equivalent.

d. Yes; Since the unit rates are the same, $\frac{\text{AED}40}{1 \text{ car}}$ the rates are equivalent.

Use Equivalent Fractions

If a unit rate is not easily found, use equivalent fractions to decide whether the ratios or rates are equivalent.

Examples

Determine if the pair of ratios or rates is equivalent. Explain your reasoning.

4. **3 free throws made out of 7 attempts; 9 free throws made out of 14 attempts**

Write each ratio as a fraction.

$\frac{3 \text{ free throws}}{7 \text{ attempts}}$ (×3) $\qquad \frac{9 \text{ free throws}}{14 \text{ attempts}}$ (×2)

The numerator and the denominator are not multiplied by the same number. So, the fractions are not equivalent.

Since the fractions are not equivalent, the ratios are not equivalent.

Examples

3. **Use unit rates to determine equivalent rates.**

AL • *How can you write 60 pages read in 3 days as a fraction? 90 pages in 6 days?* $\frac{60 \text{ pages}}{3 \text{ days}}$; $\frac{90 \text{ pages}}{6 \text{ days}}$

OL • *Are the unit rates the same? Explain.* no; Sample answer: Fatima's reading rates are 20 pages per day and 15 pages per day, which are not equivalent.

BL • *How could you solve this problem another way?* Sample answer: 6 days is two times the 3 days, but 90 pages is not twice the 60 pages, so the rates are not equivalent.

Need Another Example?

You can buy 3 medium pizzas at The Pizza Place for AED 5 medium pizzas for AED 30. Are these rates equivalent? Explain your reasoning. yes; Since the unit rates are the same, $\frac{\text{AED } 6}{1 \text{ pizza}}$ the rates are equivalent.

4. **Use equivalent fractions to determine if ratios or r are equivalent.**

AL • *How can you write 3 free throws made out of 7 attempts as a fraction?* $\frac{3 \text{ free throws}}{7 \text{ attempts}}$

• *How can you write 9 free throws made out of 14 attempts as a fraction?* $\frac{9 \text{ free throws}}{14 \text{ attempts}}$

OL • *Are these two fractions are equivalent? Explain.* no; because the numerator and denominator of the first fra can not be multiplied by the same number to result in th second fraction.

BL • *How could you solve this problem another way?* Sample answer: 7 is half of 14, but 3 is not half of 9, so t rates are not equivalent.

Need Another Example?

Determine if the rates 5 laps swam in 8 minutes and 11 lap swam in 16 minutes are equivalent. Explain your reasonin no; Since the fractions are not equivalent, then the rates are n equivalent.

Example

3. **Fatima read the first 60 pages of a book in 3 days. She read the last 90 pages in 6 days. Are these reading rates equivalent? Explain your reasoning.**

$\frac{60 \text{ pages}}{3 \text{ days}} = \frac{20 \text{ pages}}{1 \text{ day}}$ (÷3) $\qquad \frac{90 \text{ pages}}{6 \text{ days}} = \frac{15 \text{ pages}}{1 \text{ day}}$ (÷6)

Since the rates do not have the same unit rate, they are not equivalent. So, Fatima's reading rates are not equivalent.

Got it? **Do these problems to find out.**

c. Maysa made 10 bracelets for 5 friends. Laila made 12 bracelets for 4 friends. Are these rates equivalent? Explain your reasoning.

d. Club A raised AED 1680 by washing 42 cars, and Club B raised AED 1520 by washing 38 cars. Are these rates equivalent? Explain your reasoning.

Proportion

A proportion is an equation stating that two ratios or rates are equivalent.

c. No; Since the unit rates, $\frac{2 \text{ bracelets}}{1 \text{ friend}}$ and $\frac{3 \text{ bracelets}}{1 \text{ friend}}$, are not the same, the rates are not equivalent.

d. Yes; Since the unit rates are the same, $\frac{\text{AED } 40}{1 \text{ car}}$, the rates are equivalent.

Use Equivalent Fractions

If a unit rate is not easily found, use equivalent fractions to decide whether the ratios or rates are equivalent.

Examples

Determine if the pair of ratios or rates is equivalent. Explain your reasoning.

4. **3 free throws made out of 7 attempts; 9 free throws made out of 14 attempts**

Write each ratio as a fraction.

$\frac{3 \text{ free throws}}{7 \text{ attempts}} \quad \frac{9 \text{ free throws}}{14 \text{ attempts}}$ (×3, ×2)

The numerator and the denominator are not multiplied by the same number. So, the fractions are not equivalent.

Since the fractions are not equivalent, the ratios are not equivalent.

Examples

3. **Use unit rates to determine equivalent rates.**

AL • *How can you write 60 pages read in 3 days as a fraction? 90 pages in 6 days?* $\frac{60 \text{ pages}}{3 \text{ days}}$; $\frac{90 \text{ pages}}{6 \text{ days}}$

OL • *Are the unit rates the same? Explain.* No; Sample answer: Fatima's reading rates are 20 pages per day and 15 pages per day, which are not equivalent.

BL • *How could you solve this problem another way?* Sample answer: 6 days is two times the 3 days, but 90 pages is not twice the 60 pages, so the rates are not equivalent.

Need Another Example?

You can buy 3 medium pizzas at The Pizza Place for AED 6. At Pizza Palace, you can buy 5 medium pizzas for AED 30. Are these rates equivalent? Explain your reasoning. Yes; Since the unit rates are the same, $\frac{\text{AED } 6}{1 \text{ pizza}}$, the rates are equivalent.

4. **Use equivalent fractions to determine if ratios or r are equivalent.**

AL • *How can you write 3 free throws made out of 7 attempts as a fraction?* $\frac{3 \text{ free throws}}{7 \text{ attempts}}$

• *How can you write 9 free throws made out of 14 attempts as a fraction?* $\frac{9 \text{ free throws}}{14 \text{ attempts}}$

OL • *Are these two fractions are equivalent? Explain.* No, because the numerator and denominator of the first fra can not be multiplied by the same number to result in th second fraction.

BL • *How could you solve this problem another way?* Sample answer: 7 is half of 14, but 3 is not half of 9, so t rates are not equivalent.

Need Another Example?

Determine if the rates 5 laps swam in 8 minutes and 11 lap swam in 16 minutes are equivalent. Explain your reasonin no; Since the fractions are not equivalent, then the rates are n equivalent.

Example

5. Use equivalent fractions to determine equivalency.

AL • *What is the cost of a package of 6 DVDs? 3 DVDs?*
AED 90; AED 45

• *If you bought two packages of 3 DVDs, how many DVDs would you buy altogether? What would be the cost?* 6 DVDs for AED 90

OL • *Are the rates equivalent? Explain.* Yes; The numerator and denominator are divided by the same number, 2.

• *How can we write the equivalent fractions?*
$\frac{6 \text{ DVDs}}{\text{AED } 90} = \frac{3 \text{ DVDs}}{\text{AED } 45}$

BL • *If a package of 8 DVDs costs AED 80, is this rate equivalent with the other two given in the example? Explain.* No; Sample answer: The numerator and denominator would not be multiplied by the same scale factor. The cost of 8 DVDs should be AED 120 for the rates to be equivalent.

Need Another Example?
Determine if the ratios 8 corrals with 56 horses and 4 corrals with 28 horses are equivalent. Explain your reasoning.
Yes; Since $\frac{8 \text{ corrals} \div 2}{56 \text{ horses} \div 2} = \frac{4 \text{ corrals}}{28 \text{ horses}}$, the ratios are equivalent.

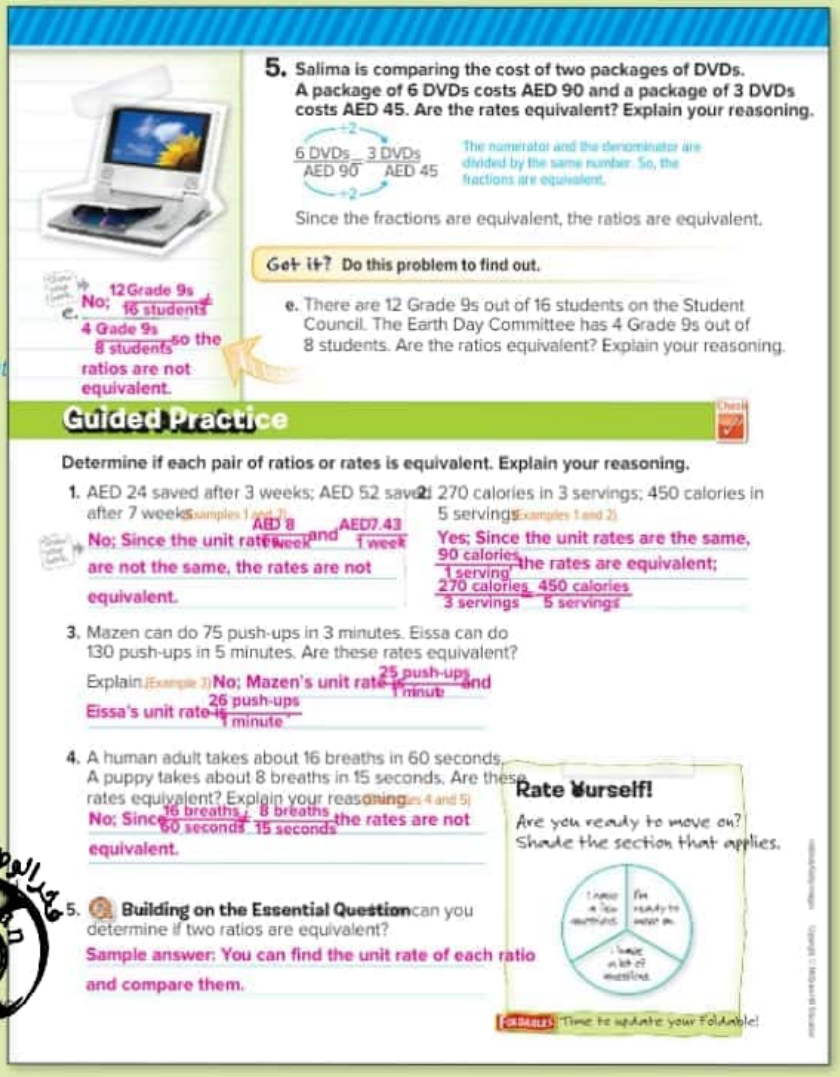
Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Think-Pair-Share** Give students a few minutes to think through their responses to Exercises 1–5. Then have pairs of students determine the solutions. Call on one pair to share their solutions with the group and, as a class, discuss and resolve any differences. MP 1, 3

BL LA **Trade-a-Problem** Ask each student to write a rate and three possible equivalent rates, only one of which is equivalent. Have them trade problems with a partner and have the partner determine which rate is equivalent. Have them justify their responses. MP 1, 3, 4



5. Salima is comparing the cost of two packages of DVDs. A package of 6 DVDs costs AED 90 and a package of 3 DVDs costs AED 45. Are the rates equivalent? Explain your reasoning.

$\frac{6 \text{ DVDs}}{\text{AED } 90} \xrightarrow{\div 2} \frac{3 \text{ DVDs}}{\text{AED } 45}$ (÷2)

The numerator and the denominator are divided by the same number. So, the fractions are equivalent.

Since the fractions are equivalent, the ratios are equivalent.

Get it? Do this problem to find out.

e. There are 12 Grade 9s out of 16 students on the Student Council. The Earth Day Committee has 4 Grade 9s out of 8 students. Are the ratios equivalent? Explain your reasoning.

No; $\frac{12 \text{ Grade 9s}}{16 \text{ students}} \neq \frac{4 \text{ Grade 9s}}{8 \text{ students}}$ so the ratios are not equivalent.

Guided Practice

Determine if each pair of ratios or rates is equivalent. Explain your reasoning.

1. AED 24 saved after 3 weeks; AED 52 saved after 7 weeks (Examples 1 and 2)
No; Since the unit rates $\frac{\text{AED } 8}{1 \text{ week}}$ and $\frac{\text{AED } 7.43}{1 \text{ week}}$ are not the same, the rates are not equivalent.

2. 270 calories in 3 servings; 450 calories in 5 servings (Examples 1 and 2)
Yes; Since the unit rates are the same, $\frac{90 \text{ calories}}{1 \text{ serving}}$, the rates are equivalent; $\frac{270 \text{ calories}}{3 \text{ servings}} = \frac{450 \text{ calories}}{5 \text{ servings}}$

3. Mazen can do 75 push-ups in 3 minutes. Eissa can do 130 push-ups in 5 minutes. Are these rates equivalent? Explain. (Example 3)
No; Mazen's unit rate is $\frac{25 \text{ push-ups}}{1 \text{ minute}}$ and Eissa's unit rate is $\frac{26 \text{ push-ups}}{1 \text{ minute}}$.

4. A human adult takes about 16 breaths in 60 seconds. A puppy takes about 8 breaths in 15 seconds. Are these rates equivalent? Explain your reasoning. (Examples 4 and 5)
No; Since $\frac{16 \text{ breaths}}{60 \text{ seconds}} \neq \frac{8 \text{ breaths}}{15 \text{ seconds}}$, the rates are not equivalent.

5. **Building on the Essential Question** can you determine if two ratios are equivalent?
Sample answer: You can find the unit rate of each ratio and compare them.

Rate Yourself!
Are you ready to move on? Shade the section that applies.

Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Determine if each pair of ratios or rates is equivalent. Explain your reasoning. (Examples 1–2, 4–5)

1. AED 3 for 6 bagels; AED 9 for 24 bagels
   No; Since the unit rates $\frac{\text{AED } 0.50}{1 \text{ bagel}}$ and $\frac{\text{AED } 0.38}{1 \text{ bagel}}$ are not the same, the rates are not equivalent.

2. AED 12 for 3 paperback books; AED 28 for 7 paperback books
   Yes; Since the unit rates are the same, $\frac{\text{AED } 4}{1 \text{ book}}$, the rates are equivalent; $\frac{\text{AED } 12}{3 \text{ books}} = \frac{\text{AED } 28}{7 \text{ books}}$

3. 3 hours worked for AED 12; 9 hours worked for AED 36
   Yes; Since $\frac{3 \text{ h} \times 3}{\text{AED } 12 \times 3} = \frac{9 \text{ h}}{\text{AED } 36}$, the fractions are equivalent; $\frac{3 \text{ h}}{\text{AED } 12} = \frac{9 \text{ h}}{\text{AED } 36}$

4. 12 minutes to drive 30 laps; 48 minutes to drive 120 laps
   Yes; Since $\frac{12 \text{ min} \times 4}{30 \text{ laps} \times 4} = \frac{48 \text{ min}}{120 \text{ laps}}$, the fractions are equivalent; $\frac{12 \text{ min}}{30 \text{ laps}} = \frac{48 \text{ min}}{120 \text{ laps}}$

5. Hessa is comparing the cost of two packages of socks. One package has 8 pairs of socks for AED 120. Another package has 3 pairs of socks for AED 60. Are the rates equivalent? Explain your reasoning.
   No; Sample answer: since $\frac{8 \text{ pairs}}{\text{AED } 120} \neq \frac{3 \text{ pairs}}{\text{AED } 60}$, the ratios are not equivalent.

6. Najla enlarged the photograph at the right to a poster. The size of the poster is 60 inches by 100 inches. Is the ratio of the poster's length and width equivalent to the ratio of the photograph's length and width? Explain your reasoning. (Example 3)

   Yes; The length to width ratio for the photograph and poster form equivalent fractions.

7. **Justify Conclusions** In a math test, it took Khalifa 30 minutes to do 6 problems. Hassan finished 18 problems in 40 minutes. Did the students work at the same rate? Explain your reasoning.
   No; Sample answer: Khalifa did $\frac{6 \text{ problems}}{30 \text{ minutes}}$ or $\frac{1 \text{ problem}}{5 \text{ minutes}}$ and Hassan did $\frac{18 \text{ problems}}{40 \text{ minutes}}$ or $\frac{9 \text{ problems}}{20 \text{ minutes}}$. So, the ratios are not equivalent.

ENGAGE EXPLORE **EXPLAIN** **ELABORATE** **EVALUATE**

3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.

Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–7, 10, 11, 20, 21
OL	On Level	1–5 odd, 7, 8, 10, 11, 20, 21
BL	Beyond Level	7–11, 20, 21

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	9, 11
3 Construct viable arguments and critique the reasoning of others.	7, 19
6 Attend to precision.	8
7 Look for and make use of structure.	10

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Tell students that the next lessons focus on solving real-world ratio and rate problems. Ask them to write a few sentences on how they think they might use equivalent ratios and rates to solve ratio and rate problems. Sample: students' work.

Watch Out!

Common Error To prevent inverting ratios, suggest that students label the units in the numerator and denominator and to keep the unit placement consistent in a subsequent ratio.

8. **Be Precise** Refer to the graphic novel frame below for Exercises a–b.

a. What is the unit price for the cans of lemonade at each of the stores?
Super Saver: $0.21 per can; Shop Smart: $0.19 per can; Price Busters: $0.25 per can

b. From which store should Musa, Rashid, and Ali purchase the cans of lemonade? Explain.
They should purchase the cans of lemonade from Shop Smart. At Shop Smart, the cost per can is the least.

H.O.T. Problems Higher Order Thinking

9. **Which One Doesn't Belong?** Identify the rate that does not belong with the other three. Justify your response.

4.5 feet per second	112.5 feet in 25 seconds	86.4 feet in 18 seconds	54 feet in 12 seconds

86.4 feet in 18 seconds; Sample answer: The other three are equivalent rates.

10. **Identify Structure** Write two ratios that are equivalent to $\frac{5}{7}$.
Sample answer: $\frac{10}{14}$ and $\frac{15}{21}$

11. **Persevere with Problems** The ratio of girls to boys in an Ajman kindergarten is 5 to 7. At the beginning of the year, there were 72 students in the kindergarten. By the end of the year, the ratio of girls to boys was 3 to 4. If there are now 48 boys in the kindergarten, how many girls joined the kindergarten during the school year? 6 girls

Name _____ My Homework _____

Extra Practice

Determine if each pair of ratios or rates is equivalent. Explain your reasoning.

12. 16 points scored in 4 games; 48 points scored in 8 games

No; $\frac{16 \text{ points}}{4 \text{ games}} = \frac{4 \text{ points}}{1 \text{ game}}$ and $\frac{48 \text{ points}}{8 \text{ games}} = \frac{6 \text{ points}}{1 \text{ game}}$ Since the unit rates are not the same, the rates are not equivalent.

13. 96 words typed in 3 minutes; 160 words typed in 5 minutes

Yes; Since the unit rates are the same $\frac{32 \text{ words}}{1 \text{ minute}}$ the rates are equivalent $\frac{96 \text{ words}}{3 \text{ minutes}} = \frac{160 \text{ words}}{5 \text{ minutes}}$

14. 15 computers for 45 students; 45 computers for 135 students

Yes; Since $\frac{15 \text{ computers}}{45 \text{ students}} \times 3 = \frac{45 \text{ computers}}{135 \text{ students}}$ the fractions are equivalent $\frac{15 \text{ computers}}{45 \text{ students}} = \frac{54 \text{ computers}}{135 \text{ students}}$

15. 16 out of 28 students own pets; 240 out of 560 students own pets

No; Since $\frac{16 \text{ students}}{28 \text{ students}} \neq \frac{40 \text{ students}}{560 \text{ students}}$ the ratios are not equivalent.

16. 288 kilometers on 12 liters of fuel; 240 kilometers on 10 liters of fuel

Yes; Since the ratios share the same unit rate, the number of kilometers driven and the number of liters of fuel form equivalent ratios; $\frac{288 \text{ km}}{12 \text{ L}} = \frac{240 \text{ km}}{10 \text{ L}}$

17. Jassim is building a model of a living room. The model sofa is 16 inches long and 7 inches deep. The real sofa's dimensions are 80 inches long and 35 inches deep. Is the ratio of the model's dimensions equivalent to the ratio of the real sofa's dimensions? Explain your reasoning.

yes; The length to width ratio for the model and sofa form equivalent fractions.

18. Store A sells 12 juice bottles for AED 4 and store B sells 18 juice bottles for AED 6. Are the rates equivalent? Explain your reasoning.

Yes; since $\frac{12 \text{ bottles}}{\text{AED } 4} = \frac{3 \text{ bottles}}{\text{AED } 1}$ and $\frac{18 \text{ bottles}}{\text{AED } 6} = \frac{3 \text{ bottles}}{\text{AED } 1}$ the fractions are equivalent. $\frac{12 \text{ bottles}}{\text{AED } 4} = \frac{18 \text{ bottles}}{\text{AED } 6}$

19. **Justify Conclusions** Hanim saved AED 35 in 5 weeks. Her sister saved AED 56 in 56 days. Are the rates at which each sister saved equivalent? Explain your reasoning.

Yes; sample answer $\frac{\text{AED } 35}{5 \text{ weeks}} = \frac{\text{AED } 7}{1 \text{ week}}$ and $\frac{\text{AED } 56}{56 \text{ days}} = \frac{\text{AED } 56}{8 \text{ weeks}}$ or $\frac{\text{AED } 7}{1 \text{ week}}$

Power Up! Test Practice

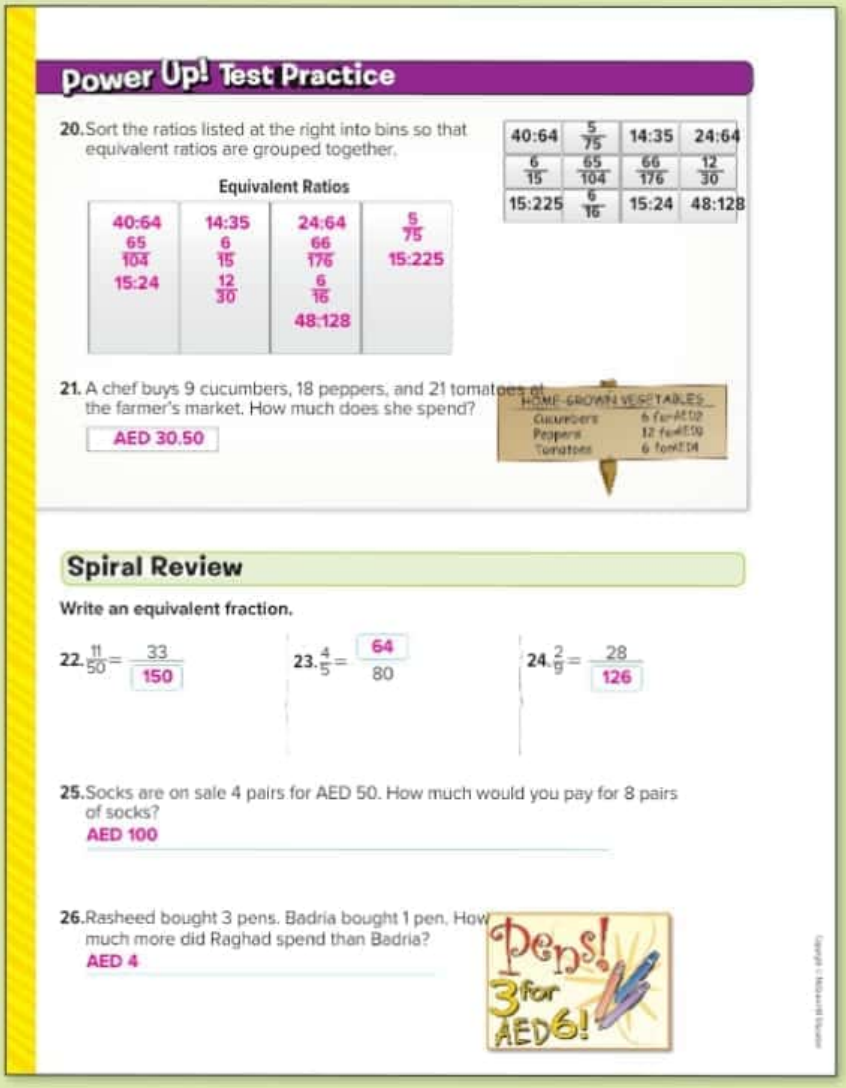
Exercises 20 and 21 prepare students for more rigorous thinking needed.

20.

This test item requires students to analyze and solve complex real-world problems through the use of mathematical tools and models.	
Depth of Knowledge	DOK2
Mathematical Practices	MP1, MP4, MP7
Scoring Rubric	
2 points	Student correctly places all 12 rates.
1 point	Student correctly places 9 of 12 rates.

21.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP4, MP7
Scoring Rubric	
1 point	The student correctly calculates a total cost of $30.50.



Power Up! Test Practice

20. Sort the ratios listed at the right into bins so that equivalent ratios are grouped together.

40:64	$\frac{5}{75}$	14:35	24:64
$\frac{6}{15}$	$\frac{65}{104}$	$\frac{66}{176}$	$\frac{12}{30}$
15:225	$\frac{6}{16}$	15:24	48:128

Equivalent Ratios

40:64 $\frac{65}{104}$ 15:24	14:35 $\frac{6}{15}$ $\frac{12}{30}$	24:64 $\frac{66}{176}$ $\frac{6}{16}$ 48:128	$\frac{5}{75}$ 15:225

21. A chef buys 9 cucumbers, 18 peppers, and 21 tomatoes at the farmer's market. How much does she spend?

AED 30.50

Spiral Review

Write an equivalent fraction.

22. $\frac{11}{50} = \frac{33}{150}$

23. $\frac{4}{5} = \frac{64}{80}$

24. $\frac{2}{9} = \frac{28}{126}$

25. Socks are on sale 4 pairs for AED 50. How much would you pay for 8 pairs of socks?

AED 100

26. Rasheed bought 3 pens. Badria bought 1 pen. How much more did Raghad spend than Badria?

AED 4

Inquiry Lab
Ratio and Rate Problems

inquiry **HOW can you use unit rates and multiplication to solve for missing measures in equivalent ratio problems?**

MP Mathematical Practices 1, 3, 4, 5, 8

Amani and Suha are racing go-karts. Amani completed 6 laps in 12 minutes. If Suha raced at the same rate, how many minutes did it take her to complete 3 laps?

What do you know? Amani completed 6 laps in 12 minutes. Suha raced at the same rate.

What do you need to find? how long it takes Suha to complete 3 laps

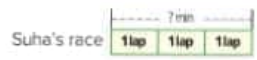
Hands-On Activity 1

Step 1 Use a bar diagram to represent the number of laps completed. The time to travel 6 laps is 12 minutes.

Step 2 Each section represents 1 lap. Determine the number of minutes it took Amani to complete one lap.

Amani completed each lap in 2 or 2 minutes.

Step 3 Determine the number of minutes it took Suha to complete 3 laps.



Each lap was completed in 2 minutes.

So, Suha's time was 3 2 , or 6 minutes.

Focus narrowing the scope

Objective Use models to solve real-world problems involving ratios and rates.

Coherence connecting within and across grades

Now Students use bar diagrams to solve ratio and rate problems.

Next Students will solve ratio and rate problems.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 69.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lab

Activities 1–3 are intended to be used as whole-group activities. Activity 1 is designed to provide more guidance to students than Activities 2 and 3.

Hands-On Activity 1

AL LA **Rally Coach** Have students work in pairs to complete Steps 1–3. Have one student read aloud each step and explain each step in their own words, while the "coach" watches, listens, and encourages. Students trade roles for each successive step. MP1

BL LA **Pairs Discussion** Have students extend the problem by having them determine the time it would take Suha to complete 4 laps. Have them explain how the completed diagram helps them determine this information. MP3, 5

8 min; Sample answer: The bar diagram shows the number of minutes (2) for each lap, so I can multiply this number by 4 laps.

Hands-On Activity 2

AL LA **Think-Pair-Draw** Have students work with a partner to complete Activity 2. Each student should read the problem scenario silently and think through their responses to Steps 1 and 2 individually. Then have them share their responses aloud with their partner. Finally, have them draw the completed bar diagram individually and solve the problem. Then have them meet with their partner to discuss and resolve any differences. MP 1, 3, 5

Ask:

- *In Step 1, why is the bar diagram separated into 4 equal sections?* To represent 4 tanks
- *How can you use the bar diagram to find the number of fish in one tank?* Divide 184 by 4 to get 46.
- *Once you know the number of fish in one tank, what can you do to find the number of fish in 3 tanks?* Multiply 46 by 3 to get 138.

Hands-On Activity 3

BL LA **Think-Pair-Write** Have students work with a partner to complete Activity 3. Then have them extend the activity by having them determine how many more miles Logan can drive in 10.5 hours than Devon. Have them first think about how to solve the problem. Then have them discuss their solution with their partner. Finally, have them individually explain how they solved the problem. MP 1, 3, 5

619.5 − 598.5, or 21 miles; See students' explanations.

Hands-On Activity 2

There are 184 goldfish at a pet store. The goldfish are in 4 tanks, each with the same number of fish. Determine how many fish are in 3 tanks.

Step 1 Use a bar diagram to represent the total number of goldfish.

184 goldfish

1 tank			

46 goldfish

Step 2 Label each section "1 tank." There are 184 ÷ 4, or 46 goldfish in each tank.

So, there are 46 · 3, or 138 goldfish in three tanks.

Hands-On Activity 3

Amer drove 171 kilometers in 3 hours. Faris drove 177 kilometers in 3 hours. At these rates, how many more kilometers can Faris drive in 7 hours than Amer?

Step 1 Use bar diagrams to represent the number of kilometers Amer and Faris drove.

Amer

171 kilometers

1 hour		

57 kilometers

Faris

177 kilometers

1 hour		

59 kilometers

Step 2 Label each section "1 hour". In one hour, Amer drove 171 ÷ 3, or 57 kilometers and Faris drove 177 ÷ 3, or 59 kilometers.

Amer will drive 7 · 57, or 399 kilometers in 7 hours. Faris will drive 7 · 59, or 413 kilometers in 7 hours. So, Faris will drive 413 − 399, or 14 more kilometers in 7 hours than Amer.

Investigate

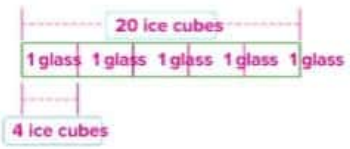
Work with a partner. Use a bar diagram to help solve each problem.

1. Determine the distance traveled in 5 hours at a rate of 189 km in 3 hours.

315 km

2. Determine the number of ice cubes in 32 glasses at a rate of 20 ice cubes in 5 glasses.

128 ice cubes



3. Determine the cost of 5 kg of bananas if 2 kg cost AED 6.50.

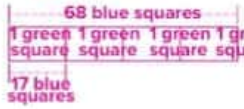
AED 16.25

4. Determine the time needed to deliver 72 papers at a rate of 9 papers in 18 minutes.

144 min

5. Predict the number of blue squares in a quilt with 11 green squares if there are 4 green squares in a quilt with 68 blue squares.

187 blue squares



6. Predict the number of roses in a garden with 16 sunflowers if there are 3 sunflowers in a garden with 81 roses.

432 roses

7. How does using a bar diagram help you in predicting the solution to ratio and rate problems?

Sample answer: By drawing a bar diagram, you can determine the unit rate and use it to predict the solution.

8. How can you use a bar diagram to check the accuracy of the solution to a ratio or rate problem?

Sample answer: The bar diagram gives a visual representation of the quantities in the rate problem. By drawing a bar diagram, repeated addition can be used to check the multiplication.

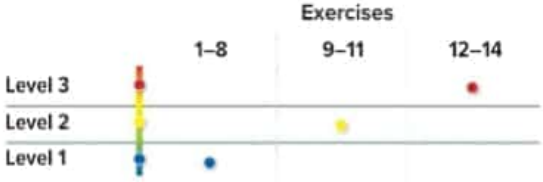
ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

2 Collaborate

The **Investigate** and **Analyze and Reflect** sections are intended to be used as small-group investigations. The **Create** section is intended to be used as independent exercises.

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level 1 indicating the lowest level of complexity.



Investigate

AL LA **Three-Step Interview** Have students work in pairs to complete Exercises 1–8 by interviewing each other. Stu 1 interviews Student 2 for Exercise 1 by asking how they s divide the bar diagram, what the value is of each section bar diagram, and what operation can they use to determi the solution to the problem. Then Student 2 interviews St 1 for Exercise 2 by asking similar questions. Have student alternate roles for each successive exercise.

MP 1, 5

BL LA **Trade-a-Problem** Have students work in small groups to write their own real-world problem involving a ratio or rate. Then have them trade problems with anothe group. Each group should draw a bar diagram to help the solve the problem. Have groups share their responses an discuss and resolve any

MP 1, 2, 4, 5

Analyze and Reflect

Pairs Discussion Have students work in pairs to complete Exercises 9–11. If students are struggling with Exercises 10 and 11, have them first draw a bar diagram. Then have them list the operations that they perform once the bar diagram has been drawn to help them answer Exercises 10 and 11. MP 1, 5, 7

Trade-a-Problem Have students complete Exercises 9–11 with a partner. Have them devise a method that can be used to solve a problem without drawing a bar diagram. Then have them write a real-world problem. Have each pair trade problems with another pair. Each pair of students should use their own method to determine if that method can indeed solve the problem written by the other pair of students. Have them adjust their method, if needed. MP 1, 2

Create

Think-Pair-Draw Have students work with a partner to complete Exercise 12. Student 1 writes the real-world problem. Then Student 2 draws a bar diagram that represents the problem. Then have them repeat the process with Student 2 writing a different real-world problem. MP 1, 5

Inquiry Students should be able to answer "HOW can you use unit rates and multiplication to solve for missing measures in equivalent ratio problems?" Check for student understanding and provide guidance, if needed.

Analyze and Reflect

Work with a partner. Refer to Exercise 4 on the previous page.

9. Suppose Yousef delivers papers at a rate of 9 papers in 18 minutes. How much longer would it take him to deliver 100 papers than 72 papers? Justify your response.

56 min; Sample answer: It takes 144 min to deliver 72 papers and 200 min to deliver 100 papers; 200 − 144 = 56

10. How can you determine the time it takes to deliver one paper without drawing a bar diagram?

Sample answer: Since 18 ÷ 9 = 2, it takes 2 min to deliver 1 paper.

11. Without using a bar diagram, explain how you would solve the following comparison problem. Then solve the problem. *Suleiman delivers papers at the rate of 6 papers in 24 minutes. How much longer would it take him to deliver 56 papers than 41 papers?*

Sample answer: Since 24 ÷ 6 = 4, I know that it takes 4 min to deliver 1 paper. Then I can find 56 × 4 = 224 and 41 × 4 = 164 and compare by subtracting. It would take him 224 − 164, or 60 more minutes.

Create

12. MP **Model with Mathematics** Obaid can read at a rate of 1,100 words in 5 minutes. Write and solve a word problem that uses this information.

Sample answer: Obaid can read 1,100 words in 5 minutes. At this rate, how many words would he read in 9 minutes? 1,980 words

13. MP **Model with Mathematics** Hind uses 42 liters of water for a 10-minute shower. Write and solve a prediction problem that uses this information.

Sample answer: Hind uses 42 liters of water in 10 minutes. At this rate, how many liters of water will she use in 8 minutes? 33.6 L

14. Inquiry HOW can you use unit rates and multiplication to solve for missing measures in equivalent ratio problems?

Sample answer: When given the initial rate, find the unit rate by creating a bar diagram. Multiply the unit rate to find the missing measure.

Lesson 7

Ratio and Rate Problems

Real-World Link

Games An arcade sells game tokens individually or in packages. They are having a sale on token packages, as shown below.

Number of Packages	Price (AED)
1	5
2	10
3	15

Essential Question

HOW do you use equivalent rates in the real world?

Mathematical Practices

1, 3, 4, 5, 7

1. How many token packages can you buy with AED 20? AED 25? 5
   Explain.
   Each package costs AED 5, so divide the total by AED 5.

2. What is the unit price?
   AED 5 per package

3. How much would it cost to buy 6 token packages?
   AED 30

4. The arcade sells individual tokens for AED 0.25 each. If a toke package contains 25 tokens, how much would you save by b a package of 25 tokens instead of 25 individual tokens? Expla
   AED 1.25; A package of 25 tokens costs AED 5 and 25 indi
   tokens cost AED 6.25. AED 6.25 − AED 5.00 = AED 1.25

Which **Mathematical Practices** do you use? Shade the circle(s) that applies.

- ① Persevere with Problems
- ② Reason Abstractly
- ③ Construct an Argument
- ④ Model with Mathematics
- ⑤ Use Math Tools
- ⑥ Attend to Precision
- ⑦ Make Use of Structure
- ⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Solve problems involving ratios and rates.

Coherence connecting within and across grades

Previous	Now	Next
Students used bar diagrams to solve problems involving ratios and rates.	Students solve problems involving ratios and rates.	Students will convert units within a measurement system.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 75.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Numbered Heads Together** Have students work in small groups to complete Exercises 1–4. Each student is assigned to a number. Students are responsible for each group member understanding each exercise before moving on to the next one. Randomly call different numbered student to share their group's respons with the clas MP 1

Alternate Strategy

AL LA Help students work backward in the table to determine the unit cost before completing Exercise 1.

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Solve a ratio problem.

AL • *Into how many sections should we divide the bar diagram? Explain.* 3; to represent the 3 students in the ratio

OL • *In setting up the equivalent fractions, how do we know whether to place the unknown value in the numerator or the denominator of the second ratio?* Since the first ratio is $\frac{2}{3}$, the numerator represents the students who prefer gel toothpaste. In the second fraction, the students who prefer gel toothpaste is the unknown, so we place the unknown in the numerator.

BL • *Compare and contrast each method. Which do you prefer?* Sample answer: The bar diagram is more visual, but setting up equivalent fractions is often quicker; See students' preferences.

Need Another Example?
A Cycle 2 school has 300 students. Sarif's class, two out of five students belong to a club. Use this ratio to predict how many students at the school belong to a club. 120

2. Solve a ratio problem.

AL • *What is the first fraction in the set of equivalent fractions? the second fraction?* $\frac{3}{4}$; $\frac{18}{\blacksquare}$

OL • *What do we multiply the numerator and denominator of the first fraction by to obtain the second fraction?* 6

BL • *How do we know that our answer is reasonable?* Sample answer: 18 is six times more than 3; 24 is six times more than 4.

Need Another Example?
In an American survey, the ratio of people who prefer football to baseball is 2 to 3. The number of people who prefer football is 36. How many people surveyed prefer baseball? 54 people

Work Zone

Equivalent Ratios

Solve Ratio Problems

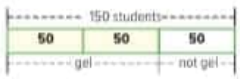
You can use bar diagrams or equations with equivalent ratios to solve ratio and rate problems.

Examples

1. A RAK Middle School has 150 students. Two out of three students in Mrs. Nouf's class prefer gel toothpaste. Use this ratio to predict how many students in the entire middle school prefer gel toothpaste.

Method 1 Use a bar diagram.

Step 1 Draw a bar diagram.



Step 2 Determine how many students are in each section.

Method 2 Use equivalent fractions.

Write an equivalent ratio.

$\frac{\text{likes gel}}{\text{total}} \rightarrow \frac{2}{3} = \frac{\blacksquare}{150} \leftarrow \frac{\text{likes gel}}{\text{total}}$

$\frac{2}{3} = \frac{100}{150}$ (×50) Since $3 \times 50 = 150$, multiply 2 by 50.

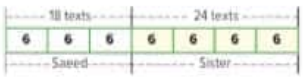
So, 100 students would prefer gel toothpaste.

2. The ratio of the number of text messages sent by Saeed to the number of text messages sent by his sister is 3 to 4. Saeed sent 18 text messages. How many text messages did his sister send?

Method 1 Use a bar diagram.

Step 1 Draw a bar diagram.

Step 2 Determine how many text messages are in each section.



Method 2 Use equivalent fractions.

Write an equivalent ratio.

Saeed → $\frac{3}{4} = \frac{18}{\square}$ ← Saeed
his sister → his sister

$\frac{3}{4} \overset{\times 6}{=} \frac{18}{24}$ Since $6 \times 3 = 18$, multiply 4 by 6.

So, Saeed' sister sent 24 text messages.

Got it? Do these problems to find out.

a. In a survey, four out of five people preferred creamy over chunky peanut butter. There are 120 people shopping at the grocery store. Use the survey to predict how many people in the store would prefer creamy peanut butter.

a. 96 people

b. A survey found that 12 out of every 15 people in the United Arab Emirates prefer eating at a restaurant over cooking at home. If 400 people selected eating at a restaurant on the survey, how many people took the survey?

b. 500 people

Stop and Reflect

What is the relationship between ratios and fractions?

Sample answer: Ratios can be written as fractions. Equivalent fractions can be used to solve ratio problems.

Solve Rate Problems

You can use double number lines or equations to solve rate problems.

Example

3. **Ali's family drove 105 kilometers on 4 liters of gasoline. At this rate, how many kilometers can they drive on 6 liters of gasoline?**

Draw a double number line.

$105 \div 4 = 26.25$ Find the unit rate.

$26.25 \times 6 = 157.5$ Multiply.

So, Ali's family can drive 157.5 kilometers on 6 liters of gasoline.

Got it? Do this problem to find out.

c. There are 810 calories in 3 scoops of vanilla ice cream. How many calories are there in 7 scoops of ice cream?

c. 1,890 cal

Example

3. **Solve a rate problem.**

AL • *What do you need to find?* the number of kilometers Ali's family can drive on 6 liters of gas

• *How many kilometers did the family drive on 4 liters of gas?* 105 kilometers

OL • *How would you find the number of kilometers they drove on 1 liter of gas?* Find 105 ÷ 4, which is 26.25.

• *How would you find the number of kilometers they drove on 6 liters of gas?* Multiply 26.25 by 6.

• *How does the double number line help you find the answer?* Sample answer: The number line helps me to see that I need to scale back to 1 liter of gas. Then I can scale forward to 6 liters of gas.

BL • *If they drove 26.25 kilometers on one liter, how far do they drive on 6 liters of gas?* 157.5 kilometers

Need Another Example?

There are 57 ounces of biscuits in 5 boxes. At this rate, how many ounces of biscuits are in 8 boxes? 91.2 oz

Example

4. Solve a rate problem.

AL • *Why do we divide by 3 to obtain Khalfan's unit rate?*
because 3 hours ÷ 3 = 1 hour

• *What is 120 divided by 40?*

OL • *What is the unit rate for Khalfan's motorcycle?* 40 kilometers per hour

• *How far can he ride in 5 hours?* 200 kilometers

BL • *If Khalfan's friend Samir can ride his motorcycle 132 kilometers in 3 hours, how much faster is Samir's rate than Khalfan's rate?* 4 kilometers per hour faster

Need Another Example?
A bakery cooks 15 cakes in 3 hours. At this rate, how many cakes can they bake in 8 hours? At what rate are they baking these cakes? 40 cakes; 5 cakes per hour

Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Roundrobin** In groups of 4, have students complete Exercises 1–4. For Exercises 1–3, have Student 1 draw a bar diagram. Student 2 writes a proportion. Student 3 uses the bar diagram and proportion to determine the solution. Student 4 checks the solution for reasonableness. Have students trade roles on each successive exercise. MP 1, 3, 5

BL LA **Trade-a-Problem** Have students write their own multi-step real-world problem, similar to Exercise 3. Then have them trade problems with a partner. Each partner solves the other's problem. Have them discuss and resolve any differences. MP 1, 3, 4

Example

4. Khalfan drove his motorcycle 120 kilometers in 3 hours. At this rate, how many kilometers can he drive in 5 hours? At what rate did he drive his motorcycle?

$\frac{120 \text{ km}}{3 \text{ hours}} = \frac{40 \text{ km}}{1 \text{ hour}}$ $\frac{120 \text{ km}}{3 \text{ hours}} = \frac{40 \text{ km}}{1 \text{ hour}}$ Find the unit rate.

$\frac{40 \text{ km}}{1 \text{ hour}} \times 5 \text{ hours} = 200 \text{ km}$ Multiply.

So, Khalfan can drive 200 km in 5 hours driving at a rate of 40 km per hour.

Got it? Do this problem to find out.

d. STEM While resting, a human takes in about 5 liters of air in 30 seconds. At this rate, how many liters of air does he take in during 150 seconds?

d. 25 L

Guided Practice

1. Out of 30 students surveyed, 17 have a cat. Based on these results, predict how many of the 300 students in the school have a cat?
170 students

2. If one out of 12 students at a school share a locker, how many share a locker in a school of 456 students? (Example 2) 38 students

3. Zahra jogged 2 kilometers in 30 minutes. At this rate, how far would she jog in 90 minutes? At what rate did she jog each hour? (Examples 3 and 4)
6 km; 4 kilometers per hour

4. **Building on the Essential Question** How can you use diagrams and equations to solve ratio and rate problems?
Sample answer: You can divide a bar diagram into the correct number of sections to find the unit rate. Use the unit rate to solve the rate or ratio problem.

Rate Yourself!
Are you ready to move on? Shade the section that applies.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

1. If 45 cookies will serve 15 students, how many cookies are needed for 30 students? (Examples 1 and 2)
90 cookies

2. Four students spent AED 12 on school lunch. At this rate, find the amount 10 students would spend on the same school lunch. (Example 2)
AED 30

3. A Clydesdale horse drinks about 120 liters of water every 4 days. At this rate, about how many liters of water does a Clydesdale drink in 28 days? (Example 3)
840 L

4. STEM In 10 minutes, a heart can beat 700 times. At this rate, how many minutes will it take for the heart to beat 140 times? At what rate does this heart beat? (Example 4)
2 min; 70 times per minute

5. **Make a Prediction** The table shows which school subjects are favored by a group of students. Predict the number of students out of 400 that would pick Science as their favorite subject.
60 students

Favorite Subject	
Subject	Number of Responses
Math	6
Science	3
English	4
Arabic	7

6. Wafa takes 4 breaths per 10 seconds during yoga. At this rate, about how many breaths would Wafa take in 2 minutes?
48 breaths

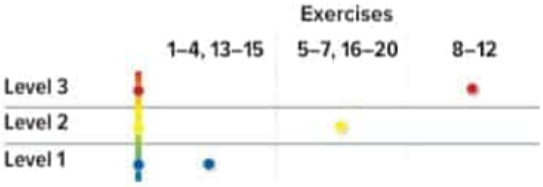
7. **Use Math Tools** Find a report in a newspaper or magazine, or on the Internet that uses results from a survey. Evaluate how the survey uses ratios to reach conclusions.
See students' work.

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

3 Practice and Apply

Independent Practice and Extra Practice
The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity
The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments
You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–5, 7–10, 12, 19, 20
OL	On Level	1, 3, 5–10, 12, 19, 20
BL	Beyond Level	5–12, 19, 20

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	11, 12
3 Construct viable arguments and critique the reasoning of others.	5, 9, 10, 16
5 Use appropriate tools strategically.	7
7 Look for and make use of structure.	8

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET
Out the Door

Have students explain how the previous lesson on equivalent ratios and rates helped them to understand this lesson on solving ratio and rate problems. See students' work.

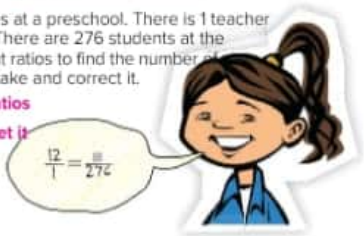
Watch Out!

Common Error When writing two equivalent ratios with an unknown quantity, advise students to use the known unit quantities to generate a factor or divisor in order to find the unknown unit quantity.

H.O.T. Problems Higher Order Thinking

8. **Identify Structure** One rate of an equivalent ratio is $\frac{9}{n}$. Select two other rates, one that can be solved using equivalent fractions and the other that can be solved with unit rates. Explain your answer. Sample answer: Equivalent fractions $\frac{18}{20} = \frac{9}{n}$; $n = 10$. Unit rate $\frac{18}{6} = \frac{3}{1} = \frac{9}{n}$; $n = 3$.

9. **Find the Error** Mahra's mother teaches at a preschool. There is 1 teacher for every 12 students at the preschool. There are 276 students at the preschool. Mahra is setting up equivalent ratios to find the number of teachers at the preschool. Find her mistake and correct it.



Mahra did not set up the equivalent ratios in the correct order. She should have set it up as $\frac{1}{12} = \frac{\blacksquare}{276}$. There are 23 teachers at the preschool.

10. **Reason Inductively** Tell whether the following statement is *always*, *sometimes*, or *never* true for numbers greater than zero. Explain.

In equivalent ratios, if the numerator of the first ratio is greater than the denominator of the first ratio, then the numerator of the second ratio is greater than the denominator of the second ratio.

Always; in order for the ratios to form equivalent ratios, they must be equivalent fractions, therefore reducing to the same fraction.

11. **Persevere with Problems** Suppose 25 out of 175 people said they like to play disc golf and 5 out of every 12 of the players have a personalized flying disc. At the same rates, in a group of 252 people, predict how many you would expect to have a personalized flying disc. Explain.

15 people; The unit rate for the people that said they like to play disc golf is $\frac{1}{7}$. In a group of 252 people, 252 ÷ 7 or 36 people would like to play disc golf. Using equivalent ratios, $\frac{5}{12} = \frac{\blacksquare}{36}$. So, 15 people would have a personalized flying disc.

12. **Persevere with Problems** A car traveling at a certain speed will travel 76 feet per second. How many miles will the car travel in 3.1 hours if it maintains the same speed? Round to the nearest tenth. (Hint: There are 5,280 feet in one mile.) 160.6 mi

Name _____ My Homework _____

Extra Practice

13. A survey reported that out of 50 teenagers, 9 said they get their news from a newspaper. At this rate, how many out of 300 teenagers would you expect to get their news from a newspaper?

54 teenagers

$\frac{50}{9} = \frac{300}{54}$ (×6)

14. Nata spent AED 28 on 2 DVDs. At this rate, how much would 5 DVDs cost? At what rate did she spend her money?

AED 70, AED 14 per DVD

15. If 15 baseballs weigh 2025 grams, how many baseballs weigh 405 grams?

3 baseballs

16. **Make a Prediction** Suppose 8 out of every 20 students are absent from school less than five days a year. Predict how many students would be absent from school less than five days a year out of 40,000 students.

16,000 students

17. For a store contest, 4 out of every 65 people who visit the store will receive a free DVD. If 455 people visit the store, how many DVDs were given away?

28 DVDs

18. There were 340,000 cattle placed on feed. Write an equivalent ratio that could be used to find how many of these cattle were between 700 and 799 pounds. How many of the 340,000 cattle placed on feed were between 700 and 799 pounds?

$\frac{2}{5} = \frac{x}{340,000}$; 136,000

Cattle Placed on Feed

Weight Group	Fraction of Total Cattle
Less than 600 pounds	$\frac{1}{5}$
600-699 pounds	$\frac{11}{50}$
700-799 pounds	$\frac{2}{5}$
800 pounds or more	$\frac{9}{50}$

Power Up! Test Practice

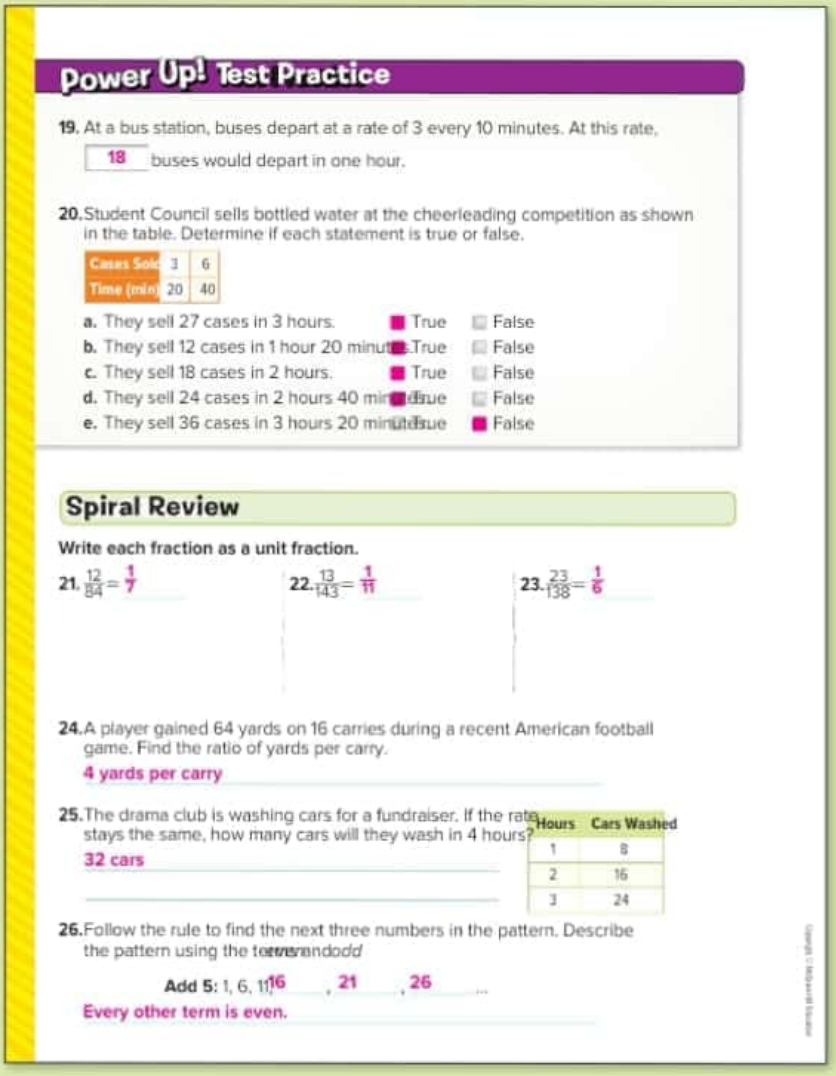
Exercises 19 and 20 prepare students for more rigorous thinking needed.

19.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP4, MP7
Scoring Rubric	
1 point	18 must be written in the answer box.

20.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practices	MP1, MP4, MP5
Scoring Rubric	
1 point	Student correctly answers true or false for each of the 5 statements.



Power Up! Test Practice

19. At a bus station, buses depart at a rate of 3 every 10 minutes. At this rate, 18 buses would depart in one hour.

20. Student Council sells bottled water at the cheerleading competition as shown in the table. Determine if each statement is true or false.

Cases Sold	3	6
Time (min)	20	40

a. They sell 27 cases in 3 hours. ■ True ☐ False
b. They sell 12 cases in 1 hour 20 minutes. ■ True ☐ False
c. They sell 18 cases in 2 hours. ■ True ☐ False
d. They sell 24 cases in 2 hours 40 minutes. ■ True ☐ False
e. They sell 36 cases in 3 hours 20 minutes. ☐ True ■ False

Spiral Review

Write each fraction as a unit fraction.

21. $\frac{12}{84} = \frac{1}{7}$

22. $\frac{13}{143} = \frac{1}{11}$

23. $\frac{23}{138} = \frac{1}{6}$

24. A player gained 64 yards on 16 carries during a recent American football game. Find the ratio of yards per carry.
4 yards per carry

25. The drama club is washing cars for a fundraiser. If the rate stays the same, how many cars will they wash in 4 hours?
32 cars

Hours	Cars Washed
1	8
2	16
3	24

26. Follow the rule to find the next three numbers in the pattern. Describe the pattern using the terms *even* and *odd*.
Add 5: 1, 6, 11, 16, 21, 26, ...
Every other term is even.

Ratios and Proportional Relationships

21ST CENTURY CAREER in Chemistry

Cosmetic Chemist

Are you naturally curious and analytical? Do you like discovering new things? If so, a career as a cosmetics chemist might be a good choice for you. Cosmetics chemists spend time researching, mixing, and testing new formulas that will make cosmetic products both effective and safe. A cosmetics chemist explained, "When you're developing a product, you play with chemicals and balance ratios to get it to feel right. Basically, it's trial and error."

Is This the Career for You?

Are you interested in a career as a cosmetics chemist? Take some of the following courses in high school.

- Algebra
- Biology
- Chemical Science
- Chemistry
- Statistics

Find out how math relates to a career in Chemisty.

Focus narrowing the scope

Objective Apply mathematics to problems arising in the workplace.

This lesson emphasizes **Mathematical Practice 4** Model with Mathematics.

Coherence connecting within and across grades

Previous Students used ratios and rates to solve problems.

Now Students apply the content standard to solve problems in the workplace.

Rigor pursuing concepts, fluency, and applications

See the Career Project on page 80.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ask students to read the information on the student page about cosmetic chemists and answer the following questi

Ask:

- *What kinds of classes should you take to be a cosmetic chemist?* Algebra, Biology, Chemical Science, Chemistry, Statistics
- *What does a cosmetic chemist do?* researches, mixes, and tests formulas for cosmetics to make sure they are safe and effective

ENGAGE EXPLORE **EXPLAIN** **ELABORATE** EVALUATE

2 Collaborate

AL LA **Think-Pair-Write** After students write down their answers to Exercises 1–6, have them work in pairs and read each other's answers. After they read the answers, have the pairs discuss their solutions. Use the following questions to help facilitate the discussion. MP 1, 3

Ask:

- *What do you need to know from the recipes to solve Exercise 3?* The total amount of lip balm in ounces.
- *How do you find the missing information from the ratio table in Exercise 6?* Sample answer: Use scaling to solve this problem. Divide to scale back and multiply to scale up.

BL LA **Circle the Sage** Have students work in teams of 3–5 students. Poll the class to see who was able to solve Exercises 5 and 6. Those students (the sages) spread out around the room. Have the teams split up with each team member going to a different sage, if possible. Have the sages explain how they completed the exercises while the classmates listen, ask questions, and take notes. MP 6

Career Portfolio

When students complete this page, have them add it to their Career Portfolio.

Career Facts

In 2005, archaeologists in south London dug up a small pot. Inside was a gray cream that still had fingerprints in it. After analyzing the cream, scientists discovered that it was a type of face makeup used by women in the second century. Chemists were able to analyze the ancient cream and reproduce it using fresh ingredients.

Beauty is Only Science Deep

Use the information in the recipes below to solve each problem.

1. Using the soap recipe, write a ratio comparing the amount of palm kernel oil to the amount of rose hydrosol as a fraction in simplest form. $\frac{3}{5}$ or 3:5
2. Write a ratio to compare the amount of jojoba oil to the total amount of the ingredients in the lip balm recipe. $\frac{1}{4}$ or 1:4
3. The lip balm costs about AED 16 to make. What is the cost per ounce? AED 0.80
4. The soap recipe makes 4 bars of soap. What is the weight per bar? 3.75 oz
5. The lip balm recipe is increased so that 10 ounces of candelilla wax is needed. Complete the ratio table to find the amount of shea butter that is needed. 30 oz

Candelilla wax	2	4	6	8	10
Shea butter	6	12	18	24	30

6. The soap recipe is increased so that 75 grams of shea butter are needed. Complete the ratio table to find the amount of sodium hydroxide that is needed. 105 g

Shea butter	30	5	75
Sodium hydroxide	42	7	105

Career Project

It's time to update your career portfolio! There are many different types of jobs in organic chemistry. Research one of these jobs and write a one- or two- or three-sentence job description.

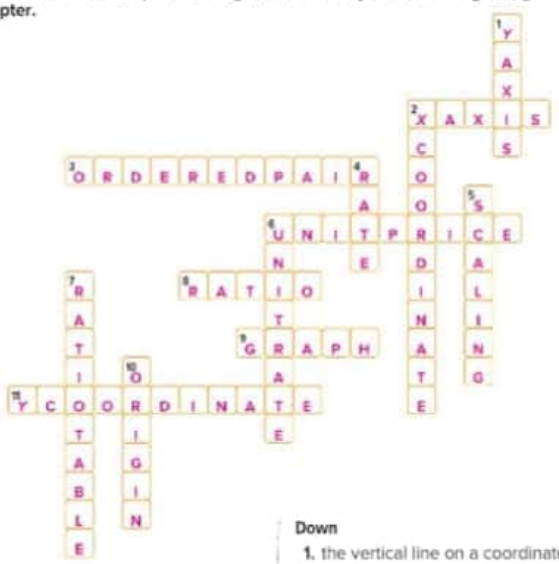
List other careers that someone with an interest in chemistry could pursue.

-
-
-
-
-

Chapter Review

Vocabulary Check

Complete the crossword puzzle using the vocabulary list at the beginning of the chapter.



Across

2. the horizontal line on a coordinate plane
3. used to locate a point on the coordinate plane
6. the cost per unit
8. a comparison of two quantities by division
9. to place a dot a the point named by an ordered pair
11. the second number of an ordered pair

Down

1. the vertical line on a coordinate plane
2. the first number of an ordered pair
4. a ratio comparing two quantities with different kinds of units
5. multiply or divide two quantities by the same number
6. a rate simplified so that it has a denominator of 1
7. columns filled with pairs of numbers that have the same ratio
10. (0, 0)

Vocabulary Check

LA **Roundtable Consensus** Have students work in teams of 3–4 to complete the Vocabulary Check. One student is assigned to be the recorder. The recorder verbally gives the answer. Teammates must give a thumbs up or thumbs down in response to the recorder's answer. All teammates must agree before the recorder writes down the answer. MP 1, 5, 6

Alternate Strategy

AL LA To help students, you may wish to give them a vocabulary list from which they can choose their answers. A vocabulary list for this activity would include the following terms.

- graph (Lesson 5)
- ordered pair (Lesson 5)
- origin (Lesson 5)
- rate (Lesson 3)
- ratio (Lesson 2)
- ratio table (Lesson 4)
- scaling (Lesson 4)
- unit price (Lesson 3)
- unit rate (Lesson 3)
- *x*-axis (Lesson 5)
- *x*-coordinate (Lesson 5)
- *y*-axis (Lesson 5)
- *y*-coordinate (Lesson 5)

Key Concept Check

FOLDABLES LA A completed Foldable for this chapter should include a review of representing equivalent ratios using numbers, diagrams, tables, and graphs.

If you choose not to use this Foldable, have students write a brief review of the Key Concepts found throughout the chapter and give an example of each.

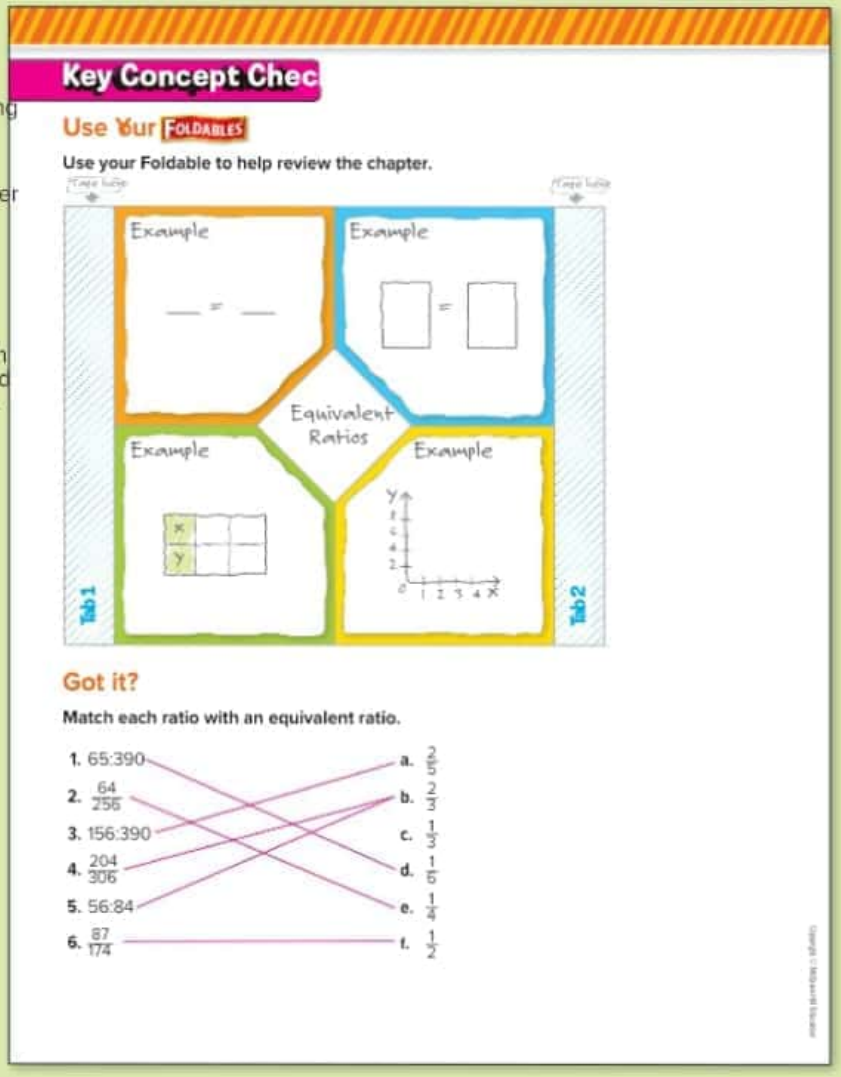
Ideas for Use

LA **Gallery Walk** Have students work with a partner to share their completed Foldables. Then have each student add or adjust anything in their Foldable based on the discussion with their partner. Display all of the Foldables around the room and have students walk around the room studying each Foldable. Have them determine if they should add anything to their Foldable based upon what they saw in others' Foldables.
MP 1, 3, 5

Got It?

If students have trouble with Exercises 1–6, they may need help with the following concept(s).

Concept	Exercise(s)
equivalent ratios (Lesson 6)	1–6



Ratios and Proportional Relationships

Power Up! Performance Task

Community Party

A local club is hosting a party at the school gym. Seeking to establish a connection with the community, the club will be providing a fun event and a meal for the children. The doors open at 6:00 P.M. and the games begin at 6:30 P.M.

Ages	Number of Children That Arrived at 6:00 P.M.	Number of Children That Arrived at 6:30 P.M.
6–10	18	6
11–14	12	4

Write your answers on another piece of paper. Show all of your work to receive full credit.

Part A
As the assistant to the party director, you are instructed to split the children into groups so there is an equal number of children in each group. Each group must also have the same number of children from each age range. At 6:00 P.M., what is the greatest number of groups that can be created? How many children of each age range are represented in each group?

Part B
Additional children arrive at 6:30 P.M. What is the greatest number of groups that can be created using the same guidelines in Part A?

Part C
The students begin to play games. Each game takes 10 minutes to complete. There are five game stations, so five games can be played at once. Based on your answer to Part B, how long will it take all the groups to play every game? Explain your answer.

Part D
Each child receives a meal, which consists of a shawarma, a bag of pretzels, and a drink for the children ages 6–10 and a shawarma, two bags of pretzels, and a drink for the children that are older than 10. It costs the club 0.80 AED for each shawarma, 0.35 AED for each bag of pretzels, and 0.60 AED for each drink. Calculate the cost to feed each age group, as well as the total cost to feed all the children.

Power Up! Performance Task

This Performance-Based Assessment requires students to solve multi-step problems through abstract reasoning, precision, and perseverance. This practice scenario can be used to help students prepare for the thinking skills that will be used on the Assessment.

A complete scoring rubric with answers to the Exercises can be found at the back of the book.

Answering the Essential Question

Before answering the Essential Question, have students review their answers to the **Building on the Essential Question** exercises found in each lesson of the chapter.

- How does finding the greatest common factor help you to solve real-world problems?
- How can you use mental math to determine if a ratio is simplified?
- How are rates and ratios related?
- How can you determine if two ratios are equivalent?
- How can graphing help solve a problem involving ratios?
- How can you determine if two ratios are equivalent?
- How can you use diagrams and equations to solve ratio and rate problems?

Ideas for Use

LA **Think-Pair-Share** Have students work in pairs. Pose the Essential Question. Give students about one minute to think about how they could complete the graphic organizer. Then have them share their responses with their classmate before they complete the graphic organizer.

Reflect

Answering the Essential Question

Use what you learned about ratios and rates to complete the graphic organizer. Sample answers are given.

Essential Question

HOW do you use equivalent rates in the real world?

Ratios	Rates
What is it? A comparison of quantities by division	What is it? A ratio comparing two quantities with different kinds of units
Examples 4 out of 5 students are taking art class	Examples walked 9 kilometers in 2 hours
Nonexamples 7 students run 1 kilometer	Nonexamples 20 out of 25 students earned an A

How are ratios and rates alike?

Both compare quantities.

How are ratios and rates different?

In a ratio, you can find a common unit between two quantities. A rate compares quantities with different units.

Answer the Essential Question HOW do you use equivalent rates in the real world?

See students' work.

Chapter 2
Fractions, Decimals, and Percents

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Mathematical Practices
1, 2, 3, 4, 5, 6, 7

Math in the Real World

Outer Space Due to the pull of gravity, an astronaut who weighs 180 pounds on Earth would weigh $\frac{1}{6}$ of that on the moon.

Write the astronaut's weight on the moon in the box below.

FOLDABLES Study Organizer

1. Cut out the Foldable in the back of this book.
2. Place your Foldable on page 166.
3. Use the Foldable throughout this chapter to help you learn about fractions, decimals, and percents.

Focus narrowing the scope

This chapter focuses on content from the **Ratios and Proportional Relationships** (RP) domain.

Coherence connecting within and across grades

Previous	Now	Next
Students used and solved ratio and rate problems.	Students convert decimals to fractions, percents to fractions and decimals, and solve percent problems.	Students will add, subtract, multiply and divide whole numbers and decimals.

Rigor pursuing concepts, fluency, and applications

The Levels of Complexity charts located throughout this chapter indicate how the exercises progress from concept understanding and procedural skills and fluency, to applic and critical thinking.

Launch the Chapter

Math in the Real World

Outer Space Show students that the astronaut's weight on the moon is $\frac{1}{6}$ of his weight on Earth by having them rew the fraction $\frac{30}{180}$ in simplest form.

What Tools Do You Need?

Vocabulary Activity

LA As you proceed through the chapter, introduce each vocabulary term using the following routine. Ask the students to say each term aloud after you say it.

Define: A percent proportion is one ratio or fraction that compares part of a quantity to the whole quantity. The other ratio is the equivalent percent written as a fraction with a denominator of 100.

Example: $\frac{3}{4} = \frac{75}{100}$ 75% of 4 = 3

Ask:

- *What is 20% of 85?*

Reading Math

Students are encouraged to connect everyday meanings to mathematical meanings of words used in mathematics to improve understanding of word problems. When completing the exercises, students should use a dictionary and choose the everyday definition of the word that is closest to the mathematical definition of the word.

LA Have students read the Everyday Meaning section.

Ask:

- *How does knowing an everyday meaning for a mathematical term help you to understand the mathematical meaning of the word?* Sample answer: If you know the everyday meaning, you can relate it to the mathematical meaning.
- *Is a factor of a number greater than or equal to, or less than or equal to the number? Explain.* Sample answer: It is less than or equal to the number because a factor helps make a product or number.
- *How can the everyday meaning of "multiple" be used to explain the mathematical meaning?* Sample answer: The everyday meaning of "multiple" is consisting of more than one or shared by many, multiples can sometimes be shared by many numbers. For example, 24 is a multiple of the numbers 1, 2, 3, 4, 6, 8, 12, and 24.

What Tools Do You Need?

Vocabulary

least common denominator	proportion
percent	rational number
percent proportion	

Study Skill: Reading Math

Everyday Meaning The key to understanding word problems is to understand the meaning of the mathematical terms in the problem.

You will use the terms *factor* and *multiple* in this chapter. Here are two sentences that show their everyday meanings.

- Weather was a *factor* in their decision to postpone the picnic.
- The star quarterback won *multiple* post-season awards.

The table shows how the everyday meaning is connected to the mathematical meaning.

Term	Everyday Meaning	Mathematical Meaning	Connection
Factor	something that actively contributes to a decision or result	2 and 3 are factors of 6.	A factor helps to make a decision. In mathematics, factors "make up" a product.
Multiple	consisting of more than one or shared by many	The multiples of 2 are 0, 2, 4, 6, ...	Multiple means many. In mathematics, a number has infinitely many multiples.

Practice Make a list of other words that have the prefixes *fac-* or *multi-*. Determine what the words in each list have in common. Sample answers are given.

Word	Meaning	Connection
faction	a group within a larger group	refer to part of something
factory	a building with the facilities for manufacturing goods	
multimedia	the combined use of several media	refer to more than one
multicultural	representing several different cultures	

What Dodu Already Know?

List three things you already know about fractions, decimals, and percents in the first section. Then list three things you would like to learn about fractions, decimals, and percents in the second section. Students' work.

Fractions, Decimals, and Percents	
What I know	What I want to find out

When Willou Use This?

Here is an example of how fractions, decimals, and percents are used in the real world.

Activity Suppose one-half of the students in your class are boys. How would you write one half as a fraction? a decimal? a percent? Which form would you use to represent one-half of the class? Explain your reasoning.

See students' work.

What Dodu Already Know?

In this activity, students assess their prior knowledge by lis three things they already know and three things they woul like to learn about concepts in the chapter.

- You may want to add a third option of "I don't know" for those students who do not have any prior knowledge of the topic.
- After completing the chapter, have students return to thi page and have them add three new facts that they learn about the topic.

When Willou Use This?

Activity

Students learn to choose when to use a fraction, decimal, percent to express a value.

Are You Ready?

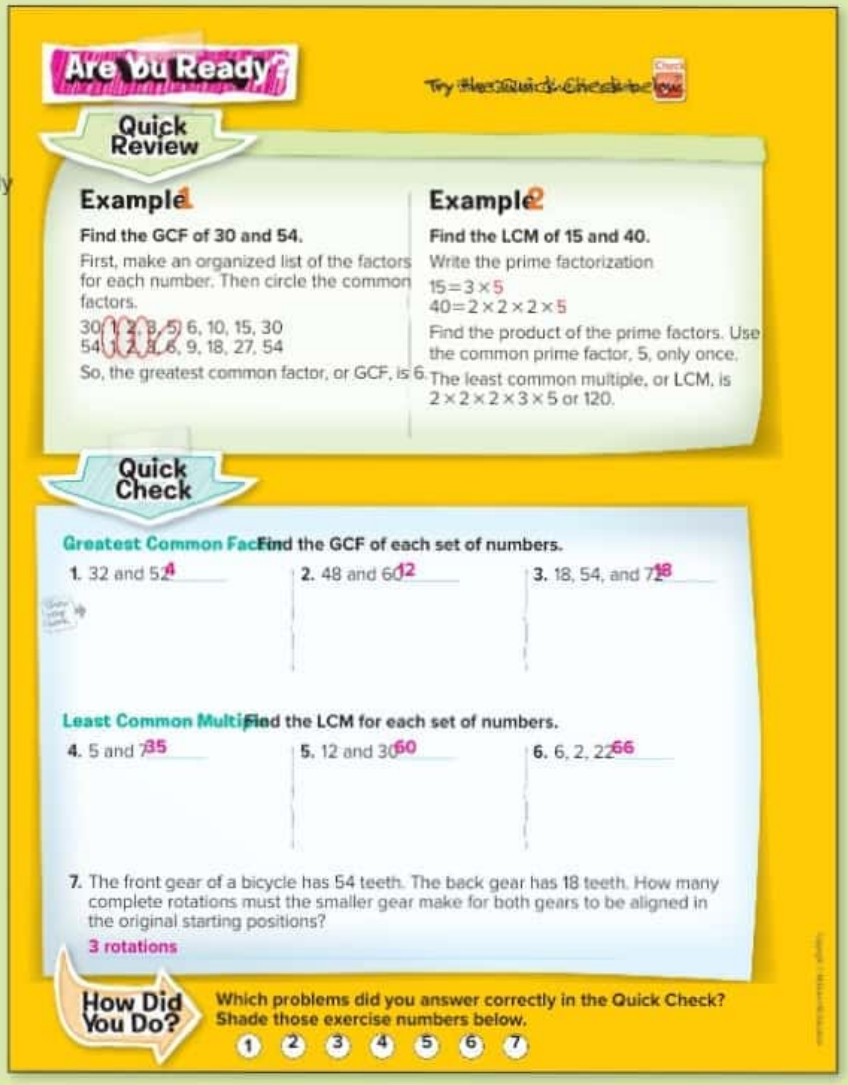
Use this page to determine if students have skills that are needed for the chapter.

Quick Review
Students with strong math backgrounds may opt to go directly to the Quick Check.

Quick Check
If students have difficulty with the exercises, present an additional example to clarify any misconceptions.

Exercises 1–3
Find the GCF of 27 and 36.

Exercises 4–6
Find the LCM of 24 and 18.



Are You Ready?

Try the Quick Check

Quick Review

Example 1

Find the GCF of 30 and 54.

First, make an organized list of the factors for each number. Then circle the common factors.

30: 1, 2, 3, 5, 6, 10, 15, 30
54: 1, 2, 3, 6, 9, 18, 27, 54

So, the greatest common factor, or GCF, is 6.

Example 2

Find the LCM of 15 and 40.

Write the prime factorization

$15 = 3 \times 5$
$40 = 2 \times 2 \times 2 \times 5$

Find the product of the prime factors. Use the common prime factor, 5, only once.

The least common multiple, or LCM, is $2 \times 2 \times 2 \times 3 \times 5$ or 120.

Quick Check

Greatest Common Factor **Find the GCF of each set of numbers.**

1. 32 and 52: 4
2. 48 and 60: 12
3. 18, 54, and 72: 18

Least Common Multiple **Find the LCM for each set of numbers.**

4. 5 and 7: 35
5. 12 and 30: 60
6. 6, 2, 22: 66

7. The front gear of a bicycle has 54 teeth. The back gear has 18 teeth. How many complete rotations must the smaller gear make for both gears to be aligned in the original starting positions?
   3 rotations

How Did You Do?

Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.

1 2 3 4 5 6 7

Ratios and Proportional Relationships

Lesson 1

Decimals and Fractions

Real-World Link

Music The instruments below show the part of students in the school orchestra that play each type of instrument.

Brass 0.25

1. Write 0.25 in word form. twenty-five hundredths
2. Write 0.25 as a fraction. $\frac{25}{100}$

Percussion 0.15

3. Write 0.15 in word form. fifteen hundredths
4. Write 0.15 as a fraction. $\frac{15}{100}$

Strings 0.31

5. Write 0.31 in word form. thirty-one hundredths
6. Write 0.31 as a fraction. $\frac{31}{100}$

Woodwind 0.29

7. Write 0.29 in word form. twenty-nine hundredths
8. Write 0.29 as a fraction. $\frac{29}{100}$

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Vocabulary

rational number

Mathematical Practices

1, 3, 4, 5

Which Mathematical Practices do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Write decimals as fractions or mixed numbers and vice versa.

Coherence connecting within and across grades

Previous	Now	Next
Students solved problems using ratios and rates.	Students write decimals as fractions and fractions as decimals.	Students will write percents as fractions and fractions as percents.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 93.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Roundrobin** Each student in a group gives or explains the answer to one or more of Exercises 1–8. Student 1 gives the answer to Exercise 1. Student 2 explains how the answer to Exercise 1 was found, and giv the answer to Exercise 2, and so on.

Alternate Strategies

AL Have students construct a place-value chart to aid in identifying the place value of the right-most digit.

BL Have students write a decimal to the thousandths pla such as 0.128, provide the word form and fraction form, in simplest form.

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Write a decimal as a fraction.

AL • *Say 0.6 in words.* six tenths

• *What fraction is represented by the words?* $\frac{6}{10}$

OL • *How do you write a fraction in simplest form?* Divide the numerator and denominator by the GCF.

• *What is the GCF of 6 and 10?* 2

BL • *What are common fraction-decimal equivalents for fractions with a denominator of 5?* $\frac{1}{5}=0.2; \frac{2}{5}=0.4; \frac{3}{5}=0.6; \frac{4}{5}=0.8; \frac{5}{5}=1$

Need Another Example?
Write 0.4 as a fraction in simplest form. $\frac{2}{5}$

2. Write a decimal as a fraction.

AL • *Say 0.45 in words.* forty-five hundredths

OL • *How is this example different than the one in Example 1?* Example 2 is to the hundredths place.

BL • *What common factor can you always use when simplifying a fraction with a numerator and denominator ending in a 0 or 5?* 5

Need Another Example?
Write 0.38 as a fraction in simplest form. $\frac{19}{50}$

3. Write a decimal as a fraction.

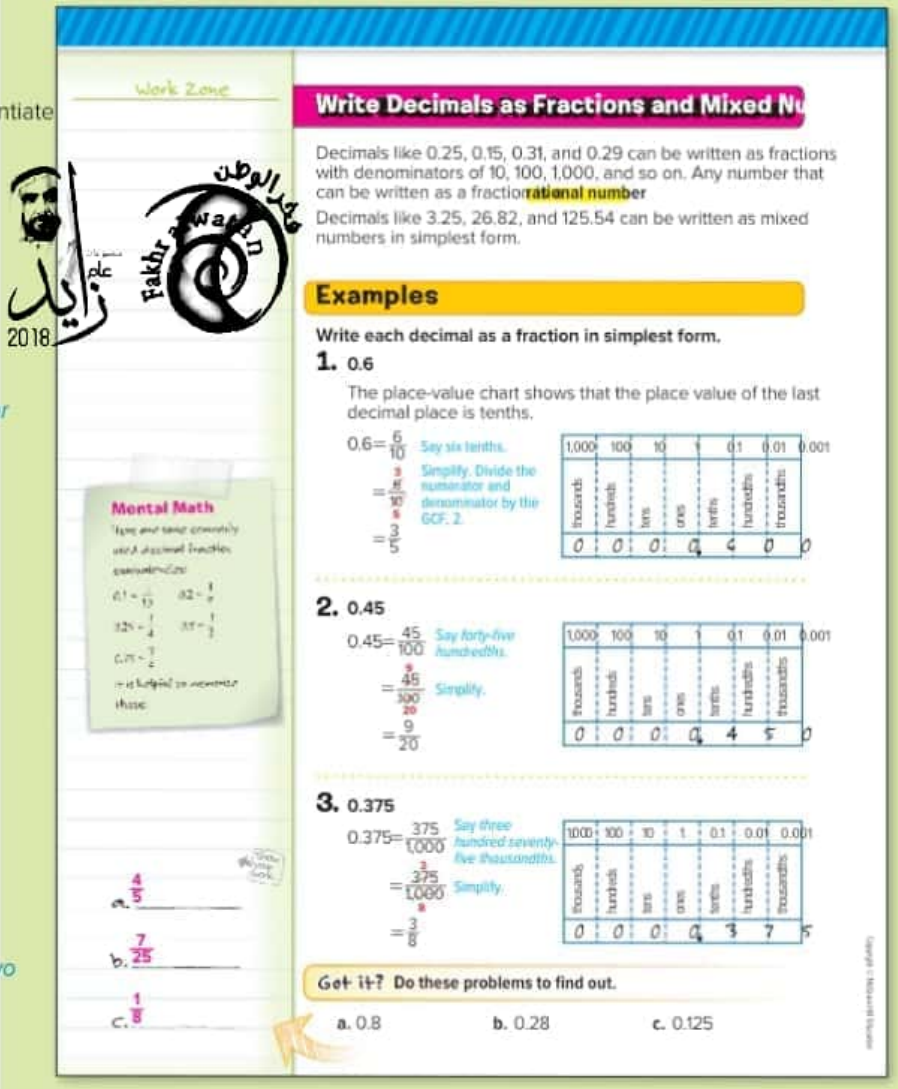
AL • *Say 0.375 in words.* three hundred seventy-five thousandths

• *What fraction is represented by the words?* $\frac{375}{1,000}$

OL • *What is the GCF of 375 and 1,000?* 125

• *How is this example different than the previous two examples?* Example 3 is to the thousandths place.

Need Another Example?
Write 0.264 as a fraction in simplest form. $\frac{33}{125}$



Work Zone

Write Decimals as Fractions and Mixed Nu

Decimals like 0.25, 0.15, 0.31, and 0.29 can be written as fractions with denominators of 10, 100, 1,000, and so on. Any number that can be written as a fraction is a **rational number**.

Decimals like 3.25, 26.82, and 125.54 can be written as mixed numbers in simplest form.

Examples

Write each decimal as a fraction in simplest form.

1. 0.6

The place-value chart shows that the place value of the last decimal place is tenths.

$0.6=\frac{6}{10}$ Say six tenths.

$=\frac{3}{5}$ Simplify. Divide the numerator and denominator by the GCF, 2.

1,000	100	10	1	0.1	0.01	0.001
thousands	hundreds	tens	ones	tenths	hundredths	thousandths
0	0	0	0	6	0	0

2. 0.45

$0.45=\frac{45}{100}$ Say forty-five hundredths.

$=\frac{9}{20}$ Simplify.

1,000	100	10	1	0.1	0.01	0.001
thousands	hundreds	tens	ones	tenths	hundredths	thousandths
0	0	0	0	4	5	0

3. 0.375

$0.375=\frac{375}{1,000}$ Say three hundred seventy-five thousandths.

$=\frac{3}{8}$ Simplify.

1000	100	10	1	0.1	0.01	0.001
thousands	hundreds	tens	ones	tenths	hundredths	thousandths
0	0	0	0	3	7	5

Mental Math

a. $\frac{4}{5}$

b. $\frac{7}{25}$

c. $\frac{1}{8}$

Got it? Do these problems to find out.

a. 0.8 b. 0.28 c. 0.125

Ratios and Proportional Relationships

Example

4. The height of the waterfall at Dubai Mall is 39.85 metres. Express 39.85 as a mixed number in simplest form.

$39.85 = 39\frac{85}{100}$ Say thirty-nine and eighty-five hundredths.

$= 39\frac{\overset{17}{\cancel{85}}}{\underset{20}{\cancel{100}}}$ or $39\frac{17}{20}$ m. Simplify.

Got it? Do these problems to find out.

d. It takes approximately 4.65 litres of milk to make a kilogram of cheese. Express this amount as a mixed number in simplest form.

d. $4\frac{13}{20}$ L

Write Fractions and Mixed Numbers as Deci

For fractions with denominators that are factors of 10, 100, or 1,000, you can write equivalent fractions with these denominators.

Example

5. Write $\frac{9}{12}$ as a decimal.

Method 1 Write an equivalent fraction.

$\frac{9}{12} = \frac{3}{4} = \frac{75}{100}$ Simplify $\frac{9}{12}$. Then multiply the numerator and denominator of $\frac{3}{4}$ by 25.

$= 0.75$ Read 0.75 as seventy-five hundredths.

Method 2 Divide the numerator by the denominator.

$\frac{9}{12} \rightarrow$

$$\begin{array}{r} 0.75 \\ 12\overline{)9.00} \\ -84 \\ \hline 60 \\ -60 \\ \hline 0 \end{array}$$

To divide 9 by 12, place a decimal point after 9 and annex as many zeros as necessary to complete the division.

Got it? Do these problems to find out.

e. $\frac{3}{5}$ f. $\frac{14}{25}$ g. $\frac{102}{250}$

e. 0.6

f. 0.56

g. 0.408

Examples

4. Write a decimal as a mixed number.

AL • *Say 9.85 in words.* nine and eighty-five hundredths

• *How do you know that the mixed number will be greater than 1?* The decimal is greater than 1.

OL • *What fraction is represented by the words?* $9\frac{85}{100}$

• *Is this in simplest form?* no

• *What is the GCF of 85 and 100?* 5

BL • *How do you know that the simplified fraction will ha a denominator of 20?* Sample answer: Decimals that have a terminating 5 in the hundredths place can be wri as a fraction with a denominator of 20.

• *Are the fractions $\frac{985}{100}$ and $9\frac{85}{100}$ equivalent? Explain.* yes; $\frac{985}{100}$ is an improper fraction. 900 hundredths equals

Need Another Example?
In 2008, Hurricane Fay produced one of the southeast's heaviest rainfalls in history. One area recorded 27.65 inch of rain. Write this amount as a mixed number in simplest form. $27\frac{13}{20}$ in.

5. Write a fraction as a decimal.

AL • *Is 12 a factor of 100?* no

• *What is $\frac{9}{12}$ written in simplest form?* $\frac{3}{4}$

OL • *What is $\frac{3}{4}$ rewritten as a fraction with a denominator of 100?* $\frac{75}{100}$

• *In Method 1, why did we have to write the fraction first?* The denominator 12 does not divide 100 evenly.

BL • *Which method do you prefer for writing the fraction a decimal? Explain.* See students' work.

• *Generate your own fraction and its decimal equiva* See students' work.

Need Another Example?
Write $\frac{12}{15}$ as a decimal. 0.8

Example

6. Write a mixed number as a decimal.

AL
- *What is $\frac{3}{8}$ in word form?* one and three-eighths
- *How do you know the decimal will be greater than 1?* The fraction is greater than 1.

OL
- *Can you rewrite $\frac{3}{8}$ as a fraction with a denominator of 10, 100, or 1,000? If so, what is it?* Yes; $\frac{3}{8}$ is equivalent to $\frac{375}{1{,}000}$
- *Why do we multiply the numerator and denominator by 125?* The denominator does not divide 100 evenly, but it does divide 1,000 evenly. $1{,}000 \div 8 = 125$

BL
- *Explain another method you could use to write $\frac{3}{8}$ as a decimal.* Sample answer: You could divide the numerator by the denominator.

Need Another Example?
The Northern Mockingbird can have a wingspan of $12\frac{3}{4}$ inches. Write this number as a decimal. 12.75

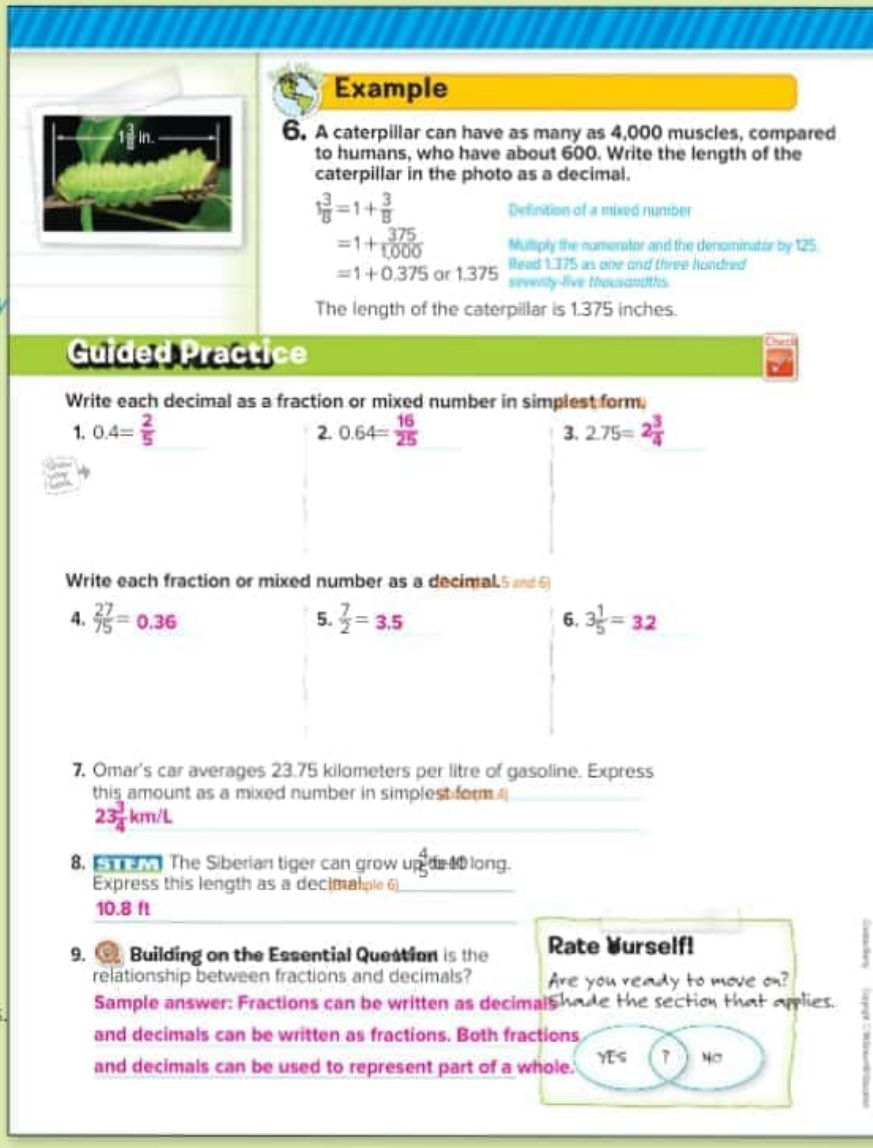
Guided Practice

Formative Assessment Review these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Rally Robin** In groups, assign one student as the Rally Robin Leader, who poses questions to help complete each exercise. The rest of the group takes turns responding orally to each question. MP 1

BL LA **Trade-a-Problem** Each student creates a problem involving a conversion from a decimal to a fraction and a problem involving a conversion of a fraction to a decimal, choosing denominators that will yield terminating decimals. They should trade problems and solve each other's problems. If the solutions do not agree, students work together to find the errors. MP 1, 4



Example

6. A caterpillar can have as many as 4,000 muscles, compared to humans, who have about 600. Write the length of the caterpillar in the photo as a decimal.

$1\frac{3}{8} = 1 + \frac{3}{8}$ Definition of a mixed number

$= 1 + \frac{375}{1{,}000}$ Multiply the numerator and the denominator by 125.

$= 1 + 0.375$ or 1.375 Read 1.375 as *one and three hundred seventy-five thousandths.*

The length of the caterpillar is 1.375 inches.

Guided Practice

Write each decimal as a fraction or mixed number in simplest form.

1. $0.4 = \frac{2}{5}$
2. $0.64 = \frac{16}{25}$
3. $2.75 = 2\frac{3}{4}$

Write each fraction or mixed number as a decimal. (5 and 6)

4. $\frac{27}{75} = 0.36$
5. $\frac{7}{2} = 3.5$
6. $3\frac{1}{5} = 3.2$

7. Omar's car averages 23.75 kilometers per litre of gasoline. Express this amount as a mixed number in simplest form. (4)
$23\frac{3}{4}$ km/L

8. STEAM The Siberian tiger can grow up to $4\frac{4}{5}$ ft long. Express this length as a decimal. (Example 6)
10.8 ft

9. **Building on the Essential Question** What is the relationship between fractions and decimals?
Sample answer: Fractions can be written as decimals and decimals can be written as fractions. Both fractions and decimals can be used to represent part of a whole.

Rate Yourself!
Are you ready to move on? Shade the section that applies.

Name _____ My Homework _____

Independent Practice

Write each decimal as a fraction in simplest form. (Example 1–3)

1. 0.5 = $\frac{1}{2}$
2. 0.7 = $\frac{7}{10}$
3. 0.33 = $\frac{33}{100}$
4. 0.875 = $\frac{7}{8}$

Write each fraction or mixed number as a decimal. (Example 5 and 6)

5. $\frac{77}{200}$ = 0.385
6. $\frac{1}{20}$ = 0.05
7. $\frac{12}{75}$ = 0.16
8. $8\frac{21}{40}$ = 8.525

9. STEM Mercury orbits the Sun in $87\frac{24}{25}$ Earth days. Venus orbits the Sun in $224\frac{7}{10}$ Earth days, and Mars orbits the Sun in $686\frac{49}{50}$ days. Write each mixed number as a decimal. (Example 6)

Mercury: 87.96; Venus: 224.7; Mars: 686.98

10. STEM Last week, a stock share gained a total of 1.64 points. Express this gain as a mixed number in simplest form. (Example 4)

$1\frac{16}{25}$

11. **Use Math Tools** The table shows the ingredients in an Italian sandwich.

Ingredient	Amount (lb)
meat	0.35
vegetables	0.15
hot sauce	0.05
bread	0.05

a. What fraction of a pound is each ingredient?

meat: $\frac{7}{20}$; vegetables: $\frac{3}{20}$; sauce: $\frac{1}{20}$; bread: $\frac{1}{20}$

b. How much more meat is in the sandwich than vegetables? Write the amount as a fraction in simplest form.

$\frac{1}{5}$ lb

c. What is the total weight of the Italian sandwich? Write the amount as a fraction in simplest form.

$\frac{3}{5}$ lb

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

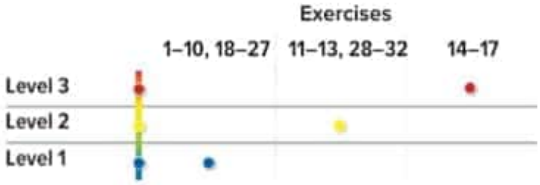
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–11, 13, 14, 16, 17, 31, 32
OL	On Level	1–9 odd, 11–14, 16, 17, 31, 32
BL	Beyond Level	11–17, 31, 32

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	15
3 Construct viable arguments and critique the reasoning of others.	14, 16
5 Use appropriate tools strategically.	11, 17, 30

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Have students write $\frac{14}{15}$ and $\frac{5}{8}$ as decimals. 0.93; 0.625

Watch Out!

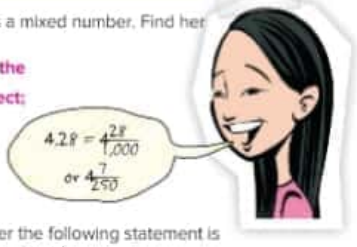
Find the Error In Exercise 14, students may not understand place value. Remind them that any digits to the left of the decimal point indicate a number that is greater than one.

12. Fawzia can run the 100-meter dash in $\frac{1}{5}$ seconds. Sumayya's best time is 19.8 seconds. How much faster is Fawzia than Sumayya in the 100-meter dash? 3.6s

13. STEAM The average length of a ladybug can range from 0.08 to 0.4 inch. Find two lengths that are within the given span. Write them as fractions in simplest form. Sample answer: $\frac{1}{5}$ in. and $\frac{7}{20}$ in.

H.O.T. Problems Higher Order Thinking

14. **Find the Error** Mariam is writing 4.28 as a mixed number. Find her mistake and correct it.
Mariam wrote the wrong place value in the denominator, so her fraction was incorrect; $4.28 = 4\frac{28}{100}$ or $4\frac{7}{25}$



15. **Persevere with Problems** Decide whether the following statement is *always*, *sometimes*, or *never* true. Explain your reasoning.

Any decimal that ends with a digit in the thousandths place can be written as a fraction with a denominator that is divisible by both 2 and 5.

Always; a decimal that ends in the thousandths place can have a denominator of 1,000. Since 1,000 is divisible by 2 and 5, the denominator of every such terminating decimal is divisible by 2 and 5.

16. **Reason Inductively** Write a fraction with a decimal value between $\frac{1}{2}$ and $\frac{3}{4}$. Write both the fraction and the equivalent decimal.
Sample answer: $\frac{7}{12} = 0.583$

17. **Use Math Tools** Noor is making a costume for her school play. She needs to buy 2 yards of cotton fabric at a cost of AED 3.49 per yard, and $\frac{1}{2}$ yard of satin fabric at AED 5.98 per yard. She has AED 15 to spend on the fabric. Use mental math to determine if she will have enough money. Explain.
yes; Sample answer: the fabric costs about AED 10, so AED 15 is enough.

Name _____ My Homework _____

Extra Practice

Write each decimal as a fraction or mixed number in simplest form.

18. 0.3 = $\frac{3}{10}$ 0.3 is three tenths.

19. 0.65 = $\frac{13}{20}$

20. 0.425 = $\frac{17}{40}$

21. 9.35 = $9\frac{7}{20}$

Write each fraction or mixed number as a decimal.

22. $\frac{19}{25}$ = 0.76

23. $\frac{311}{500}$ = 0.622

24. $\frac{5}{8}$ = 0.625

25. $14\frac{3}{5}$ = 14.6

26. Eiman lives 0.85 mile from her school. Write this distance as a fraction in simplest form.
$\frac{17}{20}$ mi

27. Al Majd Model Boys School has an average of $23\frac{3}{8}$ students per teacher. Write this mixed number as a decimal.
23.375

28. Ali bought 20 meters of fencing. He used 5.9 meters to surround one flower garden and 10.3 meters to surround another garden. Write the amount remaining as a fraction in simplest form.
$3\frac{4}{5}$ m

29. In a survey, 9 out of 15 students named Math as their favorite subject. Express this rate as a decimal.
0.6

30. **Use Math Tools** The frequency table shows the favorite college football teams of U.S. middle school students. What fraction of the students chose the Sooners? Write the fraction as a decimal.
$\frac{1}{4}$ 0.25

Team	Tally	Frequency
Buckeyes	|	3
Gators	𝍸 |	6
Sooners	𝍸	5
Tigers	|	2
Lions	||	4

Power Up! Test Practice

Exercises 31 and 32 prepare students for more rigorous thinking needed for the assessment.

31.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP6
Scoring Rubric	
1 point	Students correctly answer the question.

32.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practices	MP5, MP6
Scoring Rubric	
2 points	Students correctly shade 4 of the 16 triangles AND correctly fill in the box.
1 point	Students correctly shade 4 of the 16 triangles OR correctly fill in the box.

Power Up! Test Practice

31. Hala ran the distances shown in the table. Write the total distance, in kilometers, as a fraction in simplest form.

Day	Distance (km)
Monday	0.35
Wednesday	0.2
Thursday	0.25

$\frac{4}{5}$ km

32. Shade 0.25 of the design. Write a fraction in simplest form to represent the shaded part of the design.

$\frac{1}{4}$

Spiral Review

Simplify each fraction.

33. $\frac{20}{100} = \frac{1}{5}$

34. $\frac{35}{100} = \frac{7}{20}$

35. $\frac{72}{100} = \frac{18}{25}$

36. $\frac{48}{100} = \frac{12}{25}$

37. Yousef made 230 flyers for training. He handed two flyers out to each student. How many students received flyers?

115 students

38. Look for a pattern and complete the table.

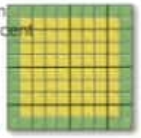
Multiplication Problem	Product
36×100	3,600
36×10	360
36×1	36
36×0.1	3.6
36×0.01	0.36

Inquiry Lab
Model Percents

inquiry **HOW can you model a percent?**

MP Mathematical Practices 1, 3, 4

Huda is using 1-inch tiles to make the mosaic shown at the right. She needs a total of 100 tiles. What percent of the tiles are green?



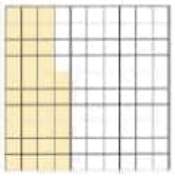
What do you know? Huda is using 1-inch tiles to make the mosaic with 100 tiles.

What do you need to find? the percent of tiles that are green

Hands-On Activity 1

A 10× 10 grid can be used to represent hundredths. It can also represent percents. The word *percent* (%) means *out of one hundred*. For example, 50% means 50 out of one hundred.

Step 1 Use a 10× 10 grid to model the percent of tiles in the mosaic that are green.



Step 2 In the mosaic, 36 tiles out of 100 are green.

As a fraction, this is $\frac{36}{100}$. When the denominator is 100, the numerator gives the numerical value of the percent.

So, 36 % of the squares are green.

Focus narrowing the scope

Objective Represent percents with concrete models.

Coherence connecting within and across grades

Now Students use models, such as 10 × 10 grids and bar diagrams, to represent percents.

Next Students will write percents as fractions and fractions as percents.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 99.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lab

Activities 1–3 are intended to be used as whole-group activities. Activity 1 is designed to provide more guidance to students than Activities 2 and 3.

Materials: 10 × 10 grid paper

Hands-On Activity 1

AL LA **Pairs Consult** Have students work in pairs to complete the activity. Have Student 1 lead the discussion for Step 1, then have Student 2 lead the discussion for Step 2. Each person is responsible to ask questions and be sure that they and their partner understand how to model a percent using a 10× 10 grid. When all pairs have completed the activity, call on one pair to present their results to the class. MP 1, 5

BL LA **Pairs Discussion** Have students discuss how they could model other percents using 10× 10 grids, such as 7%, 22.5%, and 103%. Have them present their results to the c MP 1, 3, 5

Hands-On Activity 2

AL LA **Think-Pair-Share** Have students work in pairs to complete Activity 2. Give students about one minute to think through their responses, without talking or writing. Then have them share their ideas with their partner. Then have students complete the activity in their texts. Finally, have each pair of students share their responses with another pair of students. MP 1, 3

BL LA **Pairs Discussion** Have students discuss how they could use a 10 × 10 grid to represent multiples of common percents, such as multiples of 1% (3%, 8%, or 13%), multiples of 10% (20%, 30%, or 40%), and multiples of 25% (50% or 75%). Then have them discuss how they would use a 10 × 10 grid to represent $33\frac{1}{3}$% or $66\frac{2}{3}$%. Have them present their results to the class. MP 1, 5

Hands-On Activity 3

AL LA **Pairs Consult** Have students work with the same partner they worked with in Activity 2. Have students create a bar diagram that represents 40%. Then have them tape the bar diagram to this page in their texts. MP 1, 5

BL LA **Pairs Discussion** Have students compare and contrast using a 10 × 10 grid or a bar diagram to represent percents. Ask them which model they would prefer to use to represent each of the following. Have them use their preferred method to represent each of the following. Have them share their responses and models with the class. MP 1, 3, 5

See students' preferences.

- a multiple of 10%, such as 30%, 50%, or 70%
- a multiple of 1%, such as 9% or 11%
- a multiple of $\frac{1}{3}$%, such as $\frac{2}{3}$%

Common percents are 1%, 10%, 25%, and $33\frac{1}{3}$%. Knowing these percents and their multiples makes mental math easier.

Hands-On Activity 2

Model 25% with a 10 × 10 grid.

Step 1 25% means 25 out of 100.

Step 2 Shade the squares, filling one column at a time.

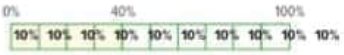
Shade 25 squares out of 100.

What fraction of the 10 × 10 grid is shaded? $\frac{25}{100}$

What decimal represents the shaded part of the grid? 0.25

Hands-On Activity 3

Percents can also be modeled with bar diagrams. The entire bar represents 100%. The bar diagram below is divided into 10 equal sections, each representing 10%. The shaded region represents 40%.



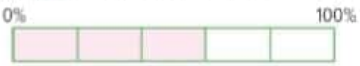
Model 60% with a bar diagram.

Step 1 The bar diagram below is divided into 5 equal sections.
To find the value of each section, divide 100 by 20%.

So, each section represents 20 %.

Step 2 20 % + 20 % + 20 % = 60%

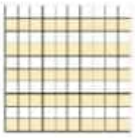
Shade 3 sections of the diagram.



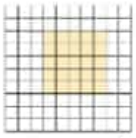
Investigate

Work with a partner. Identify each percent modeled.

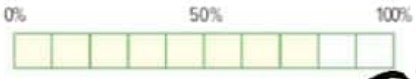
1. 50%



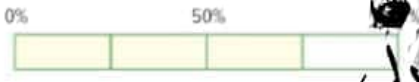
2. 25%



3. 80%



4. 75%

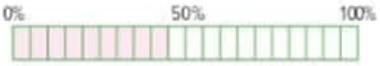


Work with a partner. Model each percent.

5. 37%

6. 8%

7. 45%



8. 5%

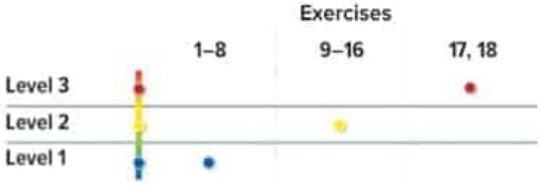
ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

2 Collaborate

The **Investigate** and **Analyze and Reflect** tions are intended to be used as small-group investigati **Create** e section is intended to be used as independent exercises.

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Investigate

AL LA **Team-Pair-Solo** ave students work as a small team to complete the odd-numbered exercises, ensuring each team member understands how to represent and id percents. Then have groups divide into pairs to complete Exercises 2 and 4. Finally, have students work individually complete the remaining exercises on the page. Upon completion, have them return to their original group to sh responses and discuss and resolve any differences.

BL LA **Pairs Consult** ave students work with a partner to extend Exercise 8 by answering the question below.

Ask:

- *How many sets of 5% are there in 100%?*
- *If the numerical value of each section was 2, what wou the numerical value of the entire bar diagram?*
- *If 100% represents the number 40, what percent would represented by the numbe 20?*
- *What percent represents 8 out o 40?*
- *What number is 20% of 80?*
- *20% of what number is 40?*

Analyze and Reflect

AL LA For Exercises 9–14, begin as a whole group. Provide selected solutions to help complete the table. Have students work in pairs to complete the remaining sections of the table. MP 1, 5

Ask:

- *How many squares are there in the 10 × 10 grid?* 100
- *How does the number in the third column relate to the number in the second column?* It is one-tenth of the value.
- *How does the number in the fourth column relate to the number in the third column?* It is double the value.

BL LA **Roundrobin** Students work in pairs to complete the table, then extend the table by adding percents, such as 20%, 75%, 90%, and 95%, and finding the number of shaded sections for each model listed in the table. MP 1, 8

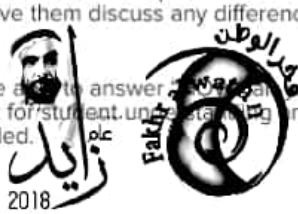
Ask:

- *When extending the table, what numbers (for the percents) can you choose to follow the same pattern?* numbers that end in 0 or 5
- *Refer to Exercise 15. Explain how you can find the percent for the model in part (a).* Sample answer: $\frac{1}{6}$ of the model is shaded, and $\frac{1}{6} \times 100 = \frac{100}{6}$. Write $\frac{100}{6}$ as a mixed number: 100 divided by 6 is 16, with a remainder of 4. So, the whole number part is 16; 4 becomes the numerator of the fraction part, with 6 as a denominator. And $\frac{4}{6}$ can be simplified to $\frac{2}{3}$. So, $\frac{100}{6} = 16\frac{2}{3}$.

Create

BL LA **Trade-a-Problem** Have students trade their problem they wrote in Exercise 17 with a partner and solve each other's problem. Have them discuss any differences in solutions. MP 1, 3

Inquiry Students should be able to answer "Yes" and explain how you model a percent?" Check for student understanding and provide guidance, if needed.



Analyze and Reflect

Sample answers: 16–18

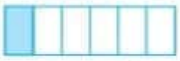
Work with a partner to determine the number of shaded sections for each model. The first one is done for you.

	Percent	Number of Shaded Sections using each Model		
		10 × 10 Grid	Bar Diagram with 10 Equal Sections	Bar Diagram with 20 Equal Sections
	45	45	4.5	9
9.	15	15	1.5	3
10.	30	30	3	6
11.	55	55	5.5	11
12.	70	70	7	14
13.	85	85	8.5	17
14.	65	65	6.5	13

15. Write the percent shown by each model. Explain your reasoning.

a.  $33\frac{1}{3}\%$; Sample answer: $\frac{1}{3}$ of the model is shaded. $\frac{1}{3}$ of 100 is $33\frac{1}{3}$.

b.  $66\frac{2}{3}\%$; Sample answer: $\frac{2}{3}$ of the model is shaded. $\frac{2}{3}$ of 100 is $66\frac{2}{3}$.

c.  $16\frac{2}{3}\%$; Sample answer: $\frac{1}{6}$ of the model is shaded. $\frac{1}{6}$ of 100 is $16\frac{2}{3}$.

16. MP **Reason Inductively** How can you use a model to write a percent as a fraction with a denominator of 100? Write the number that comes before the percent symbol over a denominator of 100.

Create

17. MP **Model with Mathematics** Write a real-world problem that involves a percent. Then model the percent used in the problem. By the time Frederick had his first basketball practice, 40% of the school year was over; See students' work for model.

18. Inquiry HOW can you model a percent? You can model a percent by using a 10 × 10 grid or a bar diagram.

Lesson 2

Percents and Fractions

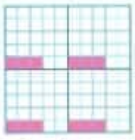
Real-World Link

Sports Students were asked to choose their favorite sport to play.

1. For each sport, shade a 10 × 10 grid that represents the number of students out of 100 that chose the sport. Sample answers are given.

Basketball 3 out of 20

Football 3 out of 25



Gymnastics 1 out of 20

Swimming 9 out of 100

2. What fraction with a denominator of 100 represents the number of students who chose each sport?

Basketball: $\frac{15}{100}$ Football: $\frac{12}{100}$

Gymnastics: $\frac{5}{100}$ Swimming: $\frac{9}{100}$

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Vocabulary

percent

Mathematical Practices

1, 3, 4, 5

Which Mathematical Practices do you use? Shade the circle(s) that applies.

- ① Persevere with Problems
- ② Reason Abstractly
- ③ Construct an Argument
- ④ Model with Mathematics
- ⑤ Use Math Tools
- ⑥ Attend to Precision
- ⑦ Make Use of Structure
- ⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Write percents as fractions and vice versa.

Coherence connecting within and across grades

Previous	Now	Next
Students used models to represent percents.	Students write equivalent forms of fractions and percents.	Students will write equivalent forms of percents and decimals.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 105.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Pairs Discussion** Have pairs complete Exercises 1 and 2. Have students meet with anot pair to compare answers and resolve any diff MP 2, 5.

Alternate Strategies

AL For basketball, help students to understand that eve two columns represents a group of 20. Have them shade 3 sections in each group o MP 2, 5

BL Have students determine if they can shade a 10 × 10 grid that represents 2 out of 33, by shading only whole square Have them justify their response. Then have them determ for which values of can they easily shade a 10 × 10 grid to represent 2 out of MP 1, 3, 5

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. **Write a percent as a fraction.**

AL • *What is a percent?* a ratio that compares a number to 100
• *What does 50% mean in words?* 50 out of 100

OL • *What fraction, with a denominator of 100, represents 50%?* $\frac{50}{100}$
• *How do we write the fraction in simplest form?* Divide the numerator and the denominator by the GCF, 50.

BL • *Of the following percents, which one would have a denominator of 100, when written as a fraction in simplest form? Explain.* 25%, 57%, 72% Sample answer: 57 and 100 do not have a GCF greater than 1.

Need Another Example?
Write 60% as a fraction in simplest form. $\frac{3}{5}$

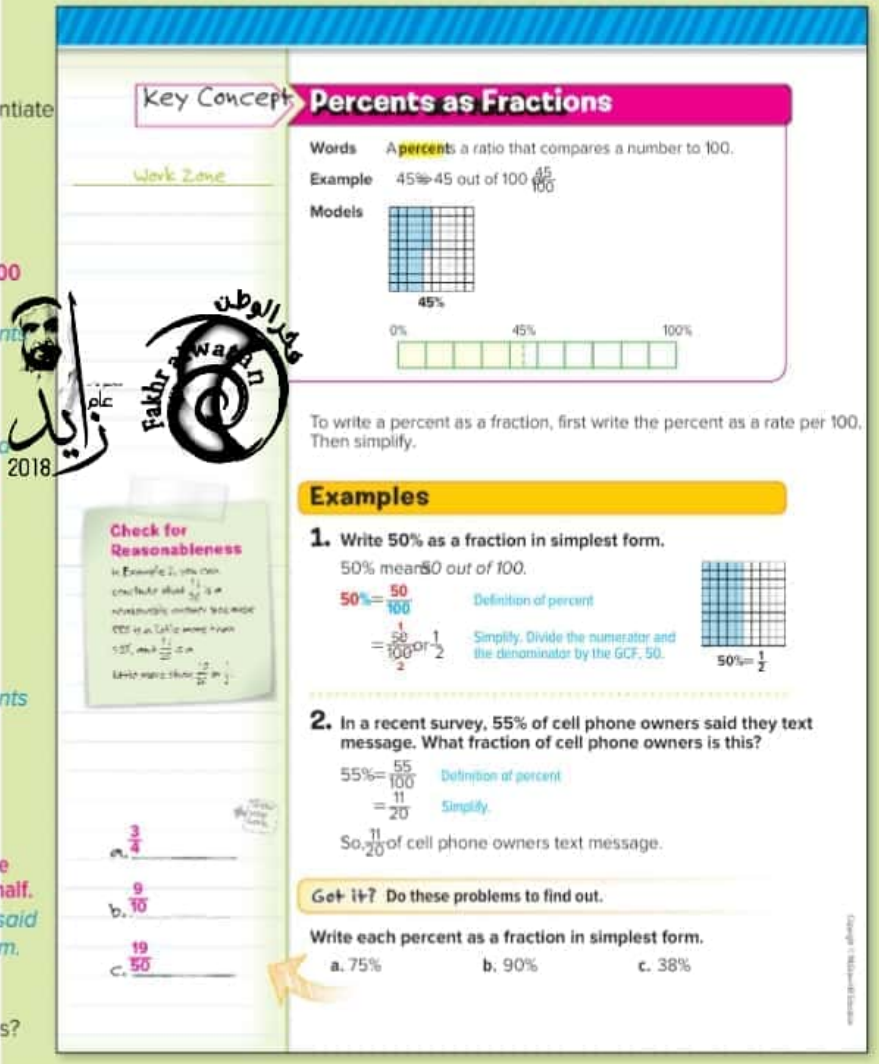
2. **Write a percent as a fraction.**

AL • *What is the percent we are given?* 55%
• *What does 55% mean in words?* 55 out of 100

OL • *What fraction, with a denominator of 100, represents 55%?* $\frac{55}{100}$
• *Is this in simplest form?* no
• *How do we write the fraction in simplest form?* Divide the numerator and the denominator by the GCF, 5.
• *How do you know that the answer is reasonable?* Sample answer: 11 out of 20 is a little more than one-half of 20 and 55% is a little more than one-half.

BL • *What fraction of the cell phone owners surveyed said they do not text message? Express in simplest form.* $\frac{9}{20}$

Need Another Example?
In a sand sculpture contest, 65% of the sculptures were castles. What fraction of the sand sculptures were castles? $\frac{13}{20}$



Key Concept **Percents as Fractions**

Words A percent is a ratio that compares a number to 100.

Example 45% = 45 out of 100 $\frac{45}{100}$

Models

To write a percent as a fraction, first write the percent as a rate per 100. Then simplify.

Examples

1. **Write 50% as a fraction in simplest form.**

50% means *50 out of 100.*

$50\% = \frac{50}{100}$ Definition of percent

$= \frac{\overset{1}{\cancel{50}}}{\underset{2}{\cancel{100}}}$ or $\frac{1}{2}$ Simplify. Divide the numerator and the denominator by the GCF, 50.

2. **In a recent survey, 55% of cell phone owners said they text message. What fraction of cell phone owners is this?**

$55\% = \frac{55}{100}$ Definition of percent

$= \frac{11}{20}$ Simplify.

So, $\frac{11}{20}$ of cell phone owners text message.

Get It? **Do these problems to find out.**

Write each percent as a fraction in simplest form.

a. 75% b. 90% c. 38%

Check for Reasonableness

a. $\frac{3}{4}$

b. $\frac{9}{10}$

c. $\frac{19}{50}$

Ratios and Proportional Relationships

Example

3. The table shows the percent of each movie type rented during a month. What fraction of the rentals were action movies?

Types of Movies	
Action	35%
Children's	5%
Comedy	45%
Drama	5%
Horror	5%
Animation	5%

$35\% = \frac{35}{100}$ Definition of percent

$= \frac{7}{20}$ Divide the numerator and denominator by the GCF, 5.

Action movies were rented $\frac{7}{20}$ of the time.

Got it? Do these problems to find out.

d. Write the fraction of rentals that were horror movies.

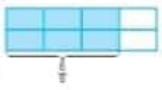
d. $\frac{1}{20}$

Fractions as Percents

To write a fraction as a percent, find an equivalent ratio with 100 as a denominator.

Example

4. Write the fraction $\frac{6}{8}$ as a percent.



$\frac{6}{8} = \frac{3}{4}$ Simplify by dividing by the GCF, 2.

$\frac{3}{4} = \frac{\square}{100}$ Write equivalent ratios. One ratio is the fraction. The other ratio is the unknown value compared to 100.

$\frac{3}{4} = \frac{75}{100}$ (×25) Since 4 × 25 = 100, multiply 3 by 25 to find the unknown value.

So, $\frac{75}{100}$ or 75% of the rectangle is shaded.

Got it? Do these problems to find out.

e. Write the fraction $\frac{9}{12}$ as a percent.

e. 75%

Examples

3. Write a percent as a fraction.

- A1 • *What is the problem asking you to find?* the fraction of the rentals that were action movies
- OL • *What fraction, with a denominator of 100, does 35% represent?* $\frac{35}{100}$
  - *Why do we divide the numerator and denominator by 5?* To write the fraction in simplest form, divide by the GCF.
- BL • *Explain how you could find the fraction of the rentals that were either comedy, drama, or horror. Then write the fraction in simplest form.* Add the percent for each of the three categories, and then write the total percent as a fraction. $45\% + 5\% + 5\% = 55\% = \frac{55}{100} = \frac{11}{20}$

Need Another Example?

The table shows what percent of each color of car is owned by people in one neighborhood. What fraction of the cars were blue? $\frac{9}{20}$

Color of Cars	
red	35%
blue	45%
gray	40%

4. Write a fraction as a percent.

- A1 • *How many sections of the model are shaded?* 6
  - *What fraction is represented by the model?* $\frac{6}{8}$
- OL • *What is $\frac{6}{8}$ in simplest form?* $\frac{3}{4}$
  - *Why do we write equivalent ratios to find the percent that is equivalent to the fraction?* To find the percent that is equivalent to the fraction $\frac{3}{4}$, we write two equivalent ratios. One is the fraction $\frac{3}{4}$. The other ratio represents the percent (the unknown value compared to 100).
  - *What is $\frac{75}{100}$ written as percent?* 75%
- BL • *Why do we simplify the fraction before expressing it with a denominator of 100?* The denominator 8 does not divide 100 evenly, but the denominator 4 does divide 100 evenly.

Need Another Example?

Write a percent to represent the shaded portion of the model.

80%

Example

5. Write a fraction as a percent.

AL • *How many shots did Ayman make in the championship game?* 12

• *How many shots did Ayman attempt in the championship game?* 40

• *What fraction represents the outcome of Ayman's shots in the championship game?* $\frac{12}{40}$

OL • *What is $\frac{12}{40}$ in simplest form?* $\frac{3}{10}$

• *What is $\frac{3}{10}$ written as a fraction with a denominator of 100?* $\frac{30}{100}$

• *What is $\frac{30}{100}$ written as a percent?* 30%

BL • *Is there another way you can solve this problem? Explain.* Sample answer: Divide 12 by 40, which equals 0.3. Then write the decimal 0.3 as three tenths, which is $\frac{3}{10}$ or $\frac{30}{100}$ which is 30%.

Need Another Example?
Ali finished 42 out of his 60 math problems in class. What percent of the math problems did Ali finish in class? 70%

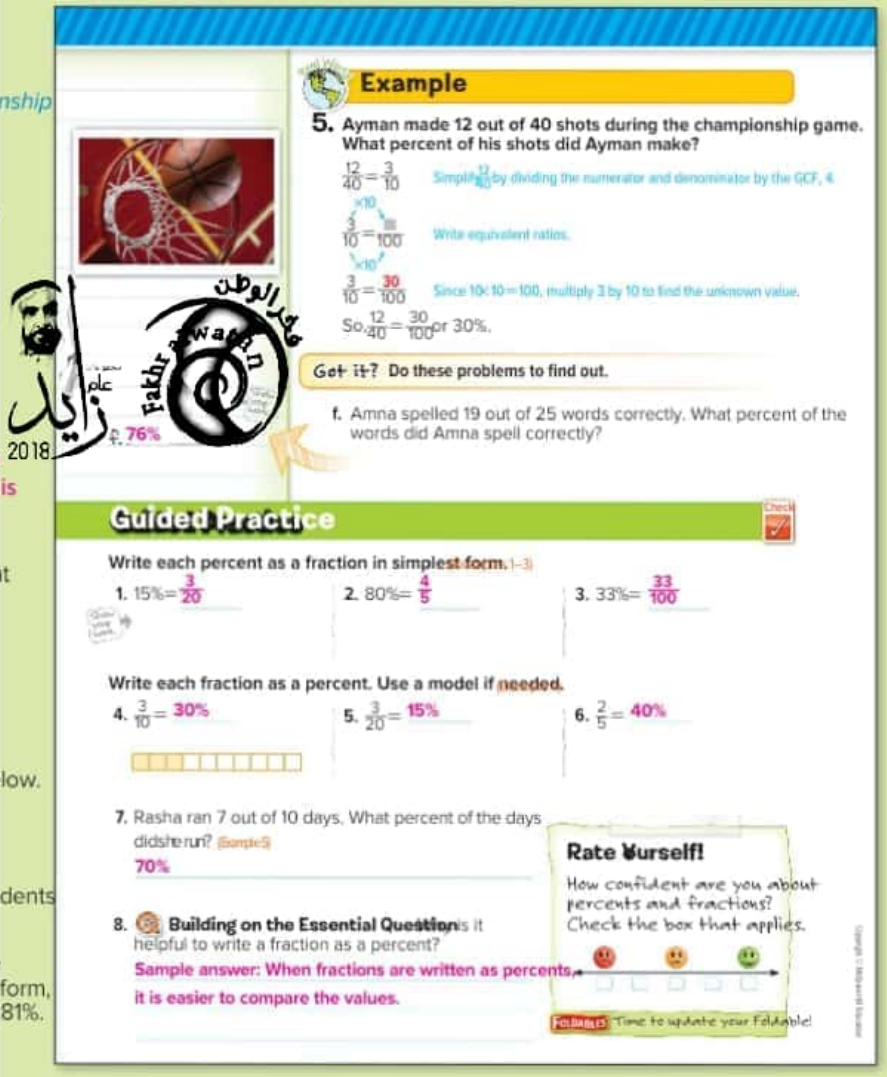
Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Roundrobin** Have pairs complete Exercises 1–3. Have Student 1 write the percent as a fraction with a denominator of 100. Student 2 simplifies the fraction, if necessary, or states that it is already simplified. Have students trade roles for each exercise. 1–4

BL LA **Pairs Consult** Have students predict which of the following percents, when written as fractions in simplest form, will have denominators of 100: 18%, 27%, 32%, 45%, and 81%. Have them justify their responses. 3, 4



Example

5. Ayman made 12 out of 40 shots during the championship game. What percent of his shots did Ayman make?

$\frac{12}{40} = \frac{3}{10}$ Simplify $\frac{12}{40}$ by dividing the numerator and denominator by the GCF, 4.

$\frac{3}{10} = \frac{30}{100}$ Write equivalent ratios.

$\frac{3}{10} = \frac{30}{100}$ Since 10 × 10 = 100, multiply 3 by 10 to find the unknown value.

So, $\frac{12}{40} = \frac{30}{100}$ or 30%.

Get it? Do these problems to find out.

f. Amna spelled 19 out of 25 words correctly. What percent of the words did Amna spell correctly? 76%

Guided Practice

Write each percent as a fraction in simplest form. (1–3)

1. 15% = $\frac{3}{20}$
2. 80% = $\frac{4}{5}$
3. 33% = $\frac{33}{100}$

Write each fraction as a percent. Use a model if needed.

4. $\frac{3}{10}$ = 30%
5. $\frac{3}{20}$ = 15%
6. $\frac{2}{5}$ = 40%

7. Rasha ran 7 out of 10 days. What percent of the days did she run? (Example 5) 70%

8. **Building on the Essential Question** Is it helpful to write a fraction as a percent?
Sample answer: When fractions are written as percents, it is easier to compare the values.

Rate Yourself!
How confident are you about percents and fractions? Check the box that applies.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Write each percent as a fraction in simplest form.

1. 2% = $\frac{1}{50}$
2. 20% = $\frac{1}{5}$
3. 85% = $\frac{17}{20}$
4. 4% = $\frac{1}{25}$

Write each fraction as a percent. Use a model if needed.

5. $\frac{2}{10}$ = 20%
6. $\frac{3}{4}$ = 75%
7. $\frac{7}{20}$ = 35%
8. $\frac{11}{25}$ = 44%

9. During his workout, Rasheed spent 28% of his time on the treadmill. What fraction of his workout was on the treadmill?
$\frac{7}{25}$

10. A cat spends about 7 out of 10 hours sleeping. About what percent of a cat's day is spent sleeping?
70%

11. A survey showed that 82% of youth most often use the internet at home. What fraction of youth surveyed most often use the internet somewhere other than home?
$\frac{9}{50}$

12. Ahmed collects a novelty coin set. He has 42 out of 50 available coins. What is 42 out of 50 as a percent?
84%

13. Use the table to determine what percent of students prefer school uniforms and what percent do not prefer school uniforms. What is the relationship between these two percents?
Do not prefer: 80%, prefer: 20%; the sum of the percents is 100%.

Prefer School Uniforms	
No	Yes

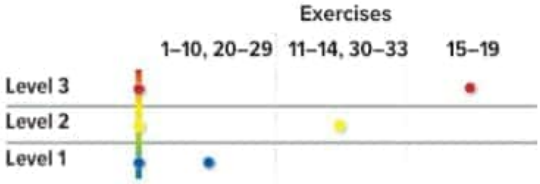
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–11, 13, 15, 17, 19, 32, 33
OL	On Level	1–9 odd, 11–15, 17, 19, 32, 33
BL	Beyond Level	11–19, 32, 33

Watch Out!

Common Error In Exercise 11, students may find the fraction and percent of students that use the Internet at home, sin that is the information given. Remind students that the remaining percent or fraction will be the difference from 1 or the difference between fractions with a denominator of

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	16, 18
3 Construct viable arguments and critique the reasoning of others.	14, 15, 17, 19
5 Use appropriate tools strategically.	30

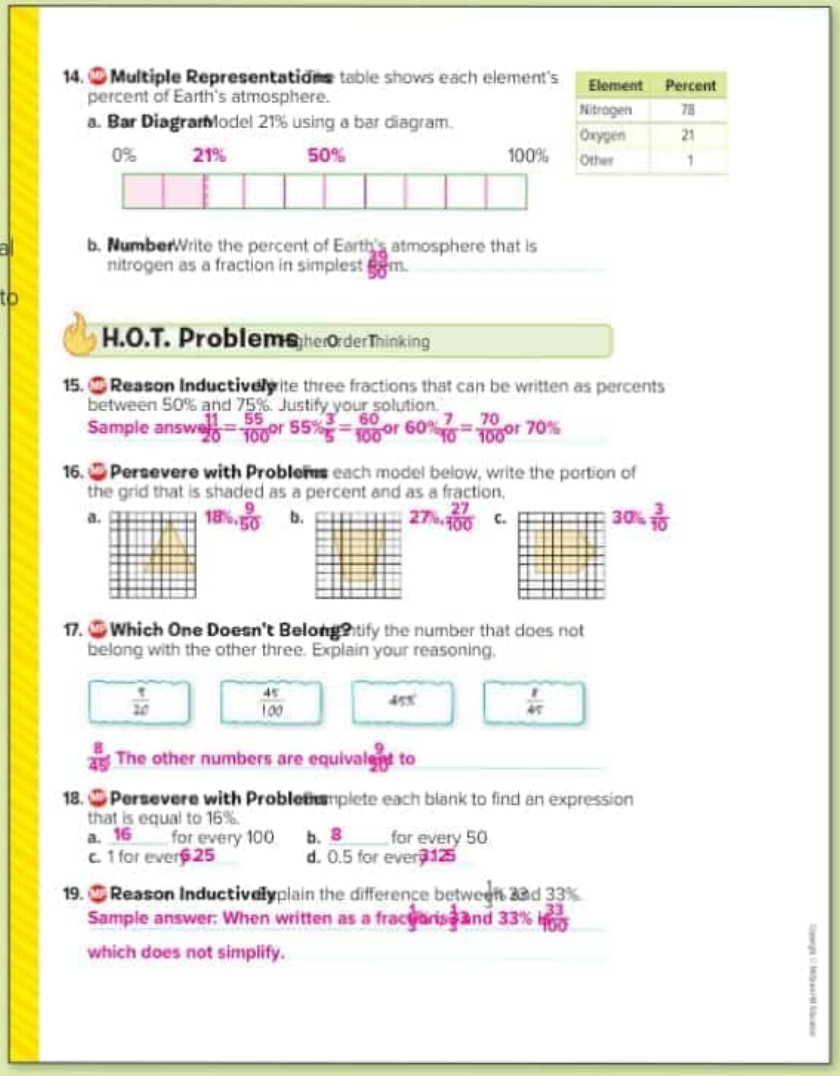
Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment

Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Have students write 35% as a fraction in simplest form. $\frac{7}{20}$



14. **Multiple Representations** The table shows each element's percent of Earth's atmosphere.

Element	Percent
Nitrogen	78
Oxygen	21
Other	1

a. **Bar Diagram** Model 21% using a bar diagram.

0% 21% 50% 100%

b. **Number** Write the percent of Earth's atmosphere that is nitrogen as a fraction in simplest form. $\frac{39}{50}$

H.O.T. Problems Higher Order Thinking

15. **Reason Inductively** Write three fractions that can be written as percents between 50% and 75%. Justify your solution.
Sample answer: $\frac{11}{20} = \frac{55}{100}$ or 55% $\frac{3}{5} = \frac{60}{100}$ or 60% $\frac{7}{10} = \frac{70}{100}$ or 70%

16. **Persevere with Problems** For each model below, write the portion of the grid that is shaded as a percent and as a fraction.

a. 18%, $\frac{9}{50}$ b. 27%, $\frac{27}{100}$ c. 30%, $\frac{3}{10}$

17. **Which One Doesn't Belong?** Identify the number that does not belong with the other three. Explain your reasoning.

$\frac{9}{20}$ $\frac{45}{100}$ 45% $\frac{8}{40}$

$\frac{8}{45}$ The other numbers are equivalent to $\frac{9}{20}$.

18. **Persevere with Problems** Complete each blank to find an expression that is equal to 16%.
a. 16 for every 100 b. 8 for every 50
c. 1 for every 6.25 d. 0.5 for every 3.125

19. **Reason Inductively** Explain the difference between $\frac{1}{3}$ and 33%.
Sample answer: When written as a fraction $\frac{1}{3}$ is $\frac{1}{3}$ and 33% is $\frac{33}{100}$ which does not simplify.

Name _____ My Homework _____

Extra Practice

Write each percent as a fraction in simplest form.

20. 14% = $\frac{7}{50}$ 14% = $\frac{14}{100}$ ÷2 $\frac{14}{100} = \frac{7}{50}$ ÷2

21. 47% = $\frac{47}{100}$

22. 86% = $\frac{43}{50}$

23. 88% = $\frac{22}{25}$

Write each fraction as a percent. Use a model if needed.

24. $\frac{7}{10}$ = 70%

25. $\frac{21}{25}$ = 84%

26. $\frac{3}{5}$ = 60%

27. $\frac{18}{25}$ = 72%

28. In a recent year, 22% of e-mail users said they spend less time using e-mail because of spam. What fraction of e-mail users is this?
$\frac{11}{50}$

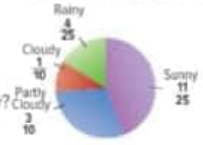
29. About $\frac{19}{20}$ of celery is water. What percent is this?
95%

30. **Use Math Tools** Mrs. Amna took a survey of the types of pants her students were wearing. She collected the data at the right. What percent of her students were wearing shorts?
36%

Type of Pants	Number of Students
Jeans	14
Shorts	9
Trousers	2

31. STEM The circle graph shows the fraction of each type of weather in London during September.

Weather During September



a. What percent of the days were sunny? 44%
b. What percent of the days were rainy? 16%
c. What percent of the days were sunny or rainy? 60%
d. What percent of the days were cloudy or partly cloudy?
40%

Power Up! Test Practice

Exercises 32 and 33 prepare students for more rigorous thinking needed for the assessment.

32.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP6
Scoring Rubric	
1 point	Students correctly answer each part of the question.

33.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP6
Scoring Rubric	
1 point	Students correctly answer the question.

Power Up! Test Practice

32. On Thursday, 65% of the sudents at a Fujairah Middle School bought a hot lunch and the rest of the students packed their lunch. What fraction of students packed their lunch? Select all that apply.

- ☐ $\frac{26}{40}$
- ■ $\frac{7}{20}$
- ☐ $\frac{18}{60}$
- ■ $\frac{28}{80}$

33. The student council published the results of the survey about the new school Mascot. Mohammed spilled water on the paper, but he knows that 72% of the students chose a mascot other than a tiger. How many students chose a Viking as their new mascot?

19 students

Mascot	Number of Students
Bear	11
Polar Bear	6
Tiger	14
Viking	?

Spiral Review

Multiply.

34. 0.685 × 100 = 685

35. 0.09 × 10 = 0.9

36. 3.255 × 100 = 325.5

37. Refer to the table. Which lap had the slowest speed?

Lap 2

Lap	Time (minutes)
1	1.59
2	1.85
3	1.64

38. Rashid has AED 10. She buys the items shown. How much will Rashid have left?

AED 2.76

Lesson 3

Percents and Decimals

Real-World Link

School A recent survey tells the favorite subjects of students at a Sharjah Middle School.

Math: 28%
Art: 16%
Science: 21%
English: 13%
Social Studies: 15%
Other: 7%

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Mathematical Practices

1, 3, 4, 5, 6

1. Write a fraction with a denominator of 100 to represent the percent for each subject.

Math: $\frac{28}{100}$ Science: $\frac{21}{100}$

Art: $\frac{16}{100}$ Social Studies: $\frac{15}{100}$

English: $\frac{13}{100}$ Other: $\frac{7}{100}$

2. Write each fraction from Exercise 1 as a decimal.

Math: 0.28 Science: 0.21

Art: 0.16 Social Studies: 0.15

English: 0.13 Other: 0.07

3. **Make a Conjecture** Look back at Exercise 2. Compare the decimals to the percents. Explain how to write a percent as a decimal. Sample answer: Take off the percent sign to show a whole number. Move the decimal point two places to the left.

Which **Mathematical Practices** do you use? Shade the circle(s) that applies.

- ① Persevere with Problems
- ② Reason Abstractly
- ③ Construct an Argument
- ④ Model with Mathematics
- ⑤ Use Math Tools
- ⑥ Attend to Precision
- ⑦ Make Use of Structure
- ⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Write percents as decimals and vice versa.

Coherence connecting within and across grades

Previous Students generated equivalent forms of percents and fractions.

Now Students write equivalent forms of percents and decimals.

Next Students will write equivalent forms of percents greater than 100% and less than 1%.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 113.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Think-Pair-Share** Give students a few minutes to think through their responses to Exercises 1–3. Then have them discuss their solutions wit partner. The group should compare answers and solution methods. Call on students from each pair to share their responses with the cla MP 3, 3

Alternate Strategy

AS Have students write each fraction in words. For example, $\frac{28}{100}$ is *twenty-eight hundredths*. Have them explain how writing the fraction in words helps them to write the fraction as a decim MP 1, 3, 4

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1–3. Write a percent as a decimal.

AL • *To write each percent as a decimal, we will first write each percent as a fraction. What denominator will we use for each fraction? Explain.* 100; Percent means "per 100".

• *What numerator will we use for Example 1? Example 2? Example 3?* 56 8 2

OL • *After writing each percent as a fraction with a denominator of 100, why do we not need to simplify each fraction in order to write it as a decimal?* Sample answer: The denominator of 100 represents hundredths. The numerator will represent the digits to the hundredths place. If we simplify, the denominator will no longer represent hundredths.

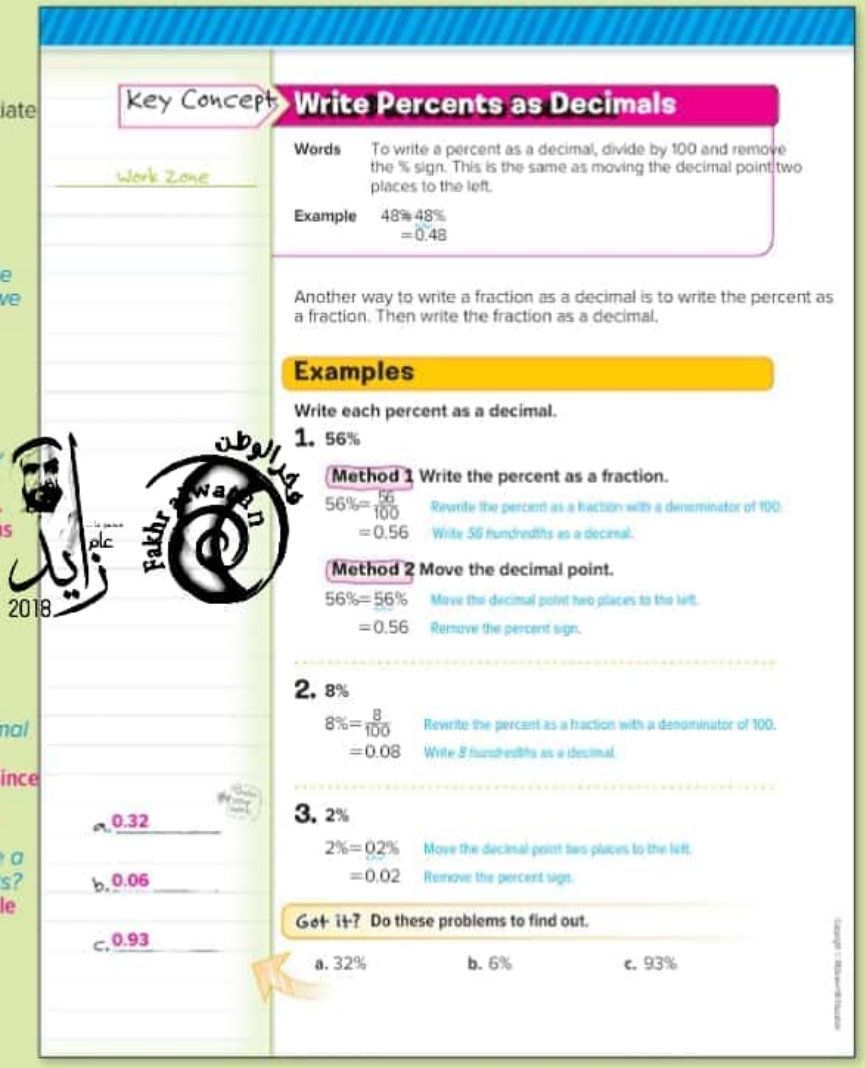
• *What is $\frac{56}{100}$ in word form? $\frac{8}{100}$? $\frac{2}{100}$?* fifty-six hundredths eight hundredths two hundredths

• *What is fifty-six hundredths written as a decimal? eight hundredths? two hundredths?* 0.56 0.08 0.02

BL • *Why is there a zero in the tenths place for the decimal equivalents of 8% and 2%?* Sample answer: 8% is eight hundredths. The 8 is the digit in the hundredths place. Since 8% = 08%, the digit in the tenths place is 0. The same is true for 2%.

• *For which percents between 0% and 100% will have a zero in the tenths place for their decimal equivalents? Explain.* 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, and 9%; Sample answer: These percents are less than 10% and 0.10%

Need Other Examples?
Write each percent as a decimal.
a. 86% 0.86 **b.** 7% 0.07 **c.** 4% 0.04



Write Decimals as Percents

Key Concept

Words To write a decimal as a percent, multiply by 100 and add a % sign. This is the same as moving the decimal point two places to the right.

Example 0.36 = 0.36% = 36%

Another way to write a decimal as a percent is to write the decimal as a fraction with a denominator of 100. Then write the fraction as a percent.

Examples

4. Write 0.38 as a percent.

Method 1 Write the decimal as a percent.

$0.38 = \frac{38}{100}$ Write 38 hundredths as a fraction.

$= 38\%$ Write the fraction as a percent.

Method 2 Move the decimal point.

$0.38 = 0.38$ Move the decimal point two places to the right.

$= 38\%$ Add the percent sign.

5. Write 0.2 as a percent.

$0.2 = \frac{2}{10}$ Write 2 tenths as a fraction.

$\frac{2}{10} = \frac{20}{100}$ Write the equivalent fraction with a denominator of 100.

$= 20\%$ Write the fraction as a percent.

Got it? Do these problems to find out.

Write each decimal as a percent.

d. 0.47 **e.** 0.73 **f.** 0.5

Stop and Reflect

Why does it help to write a decimal as a fraction with a denominator of 100 when writing decimals as percents?

A percent is a rate per 100. When a decimal has a denominator of 100, it is easily converted to a percent.

d. 47%

e. 73%

f. 50%

Examples

4. Write a decimal as a percent.

AL • *What is 0.38 in word form?* thirty-eight hundredths

• *What is thirty-eight hundredths written as a fraction?* $\frac{38}{100}$

OL • *How do we write $\frac{38}{100}$ as a percent?* The denominator is already 100, so the numerator becomes the percent. Write the numerator, without the denominator, and add a percent symbol: $\frac{38}{100} = 38\%$.

• *Why do we write 38 hundredths as a fraction with a denominator of 100?* Sample answer: A percent is a ratio per 100, so we need to find the numerator of the fraction with a denominator of 100.

BL • *How would you express 0.09 as a percent?* Sample answer: 0.09 is nine hundredths, or $\frac{9}{100}$. So, $0.09 = 9\%$.

Need Another Example?
Write 0.44 as a percent. 44%

5. Write a decimal as a percent.

AL • *What is 0.2 in word form?* two tenths

• *What is two tenths written as a fraction?* $\frac{2}{10}$

OL • *How would you write $\frac{2}{10}$ as a fraction with a denominator of 100?* Multiply the numerator and denominator by 10.

• *When you multiply the numerator and denominator by 10, what does the numerator become?* 20

BL • *If you drew a bar diagram to represent 0.2, into how many equal sections will you divide the bar?* Sample answer: 10
How many will be shaded? Sample answer: 2

• *How would you write 0.02 as a percent? 0.002?* Sample answer: 0.02 is two hundredths, or $\frac{2}{100}$. So, $0.02 = 2\%$; 0.002 is two thousandths, or $\frac{2}{1{,}000} = \frac{0.2}{100}$. So, $0.002 = 0.2\%$.

Need Another Example?
Write 0.3 as a percent. 30%

Example

6. Write the decimal as a percent.

AL • *What do you need to do to write 0.4 as a percent.*

• *What does 0.4 become when you annex a zero?* 0.40

OL • *What is 0.40 in word form?* forty hundredths

• *What is forty hundredths written as a fraction?* $\frac{40}{100}$

BL • *What percent of corn is produced by all of the other countries combined?* 60%

• *Suppose your friend told you that to write a decimal as a percent, you simply move the decimal point two places to the right and add the percent sign. Does this method work? Explain.* yes; Sample answer: A digit in one place is 10 times the value of that same digit in the place to its right. So, multiplying by 100, or 10 × 10, results in the decimal point being moved two places to the right.

Need Another Example?

About 0.51 of a city's population is female. Write 0.51 as a percent. 51%

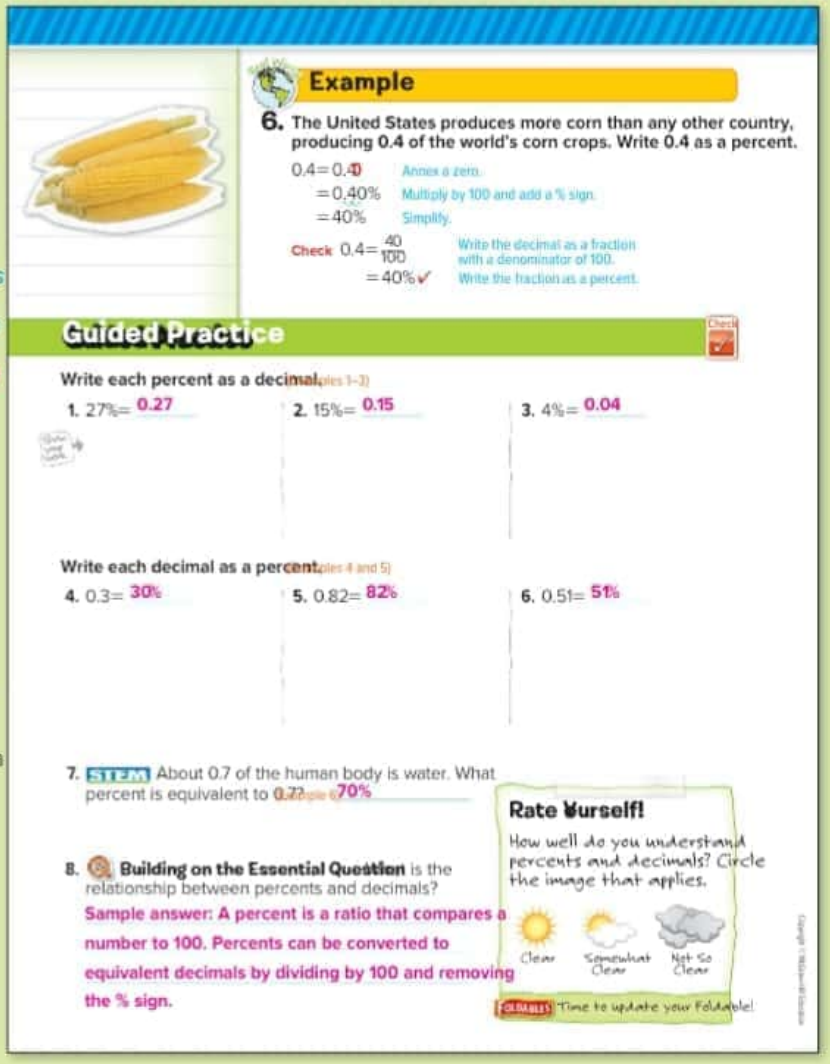
Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Roundrobin** Have the students complete Exercises 1–8 in pairs. For each exercise, have one student contribute a step. Then the next student contributes a step, and so on. For example, in Exercise 1, Student 1 writes the number as a fraction. Student 2 writes the fraction as a decimal. Have students alternate roles until the exercise has been completed. MP 1, 4

BL LA **Pairs Discussion** Students may choose to simply move the decimal point to the right two places to write a decimal as a percent and to the left two places to write a percent as a decimal. Ask students to use multiplication and division by a power of 10 to explain why this method works. MP 1, 3, 4



Example

6. The United States produces more corn than any other country, producing 0.4 of the world's corn crops. Write 0.4 as a percent.

$0.4 = 0.40$ Annex a zero.

$= 0.40\%$ Multiply by 100 and add a % sign.

$= 40\%$ Simplify.

Check $0.4 = \frac{40}{100}$ Write the decimal as a fraction with a denominator of 100.

$= 40\%$ ✓ Write the fraction as a percent.

Guided Practice

Write each percent as a decimal. (Examples 1–3)

1. 27% = 0.27
2. 15% = 0.15
3. 4% = 0.04

Write each decimal as a percent. (Examples 4 and 5)

4. 0.3 = 30%
5. 0.82 = 82%
6. 0.51 = 51%

7. STEAM About 0.7 of the human body is water. What percent is equivalent to 0.7? (Example 6) 70%

8. **Building on the Essential Question** is the relationship between percents and decimals?

Sample answer: A percent is a ratio that compares a number to 100. Percents can be converted to equivalent decimals by dividing by 100 and removing the % sign.

Rate Yourself!

How well do you understand percents and decimals? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Write each percent as a decimal. (Examples 1–3)

1. 35%= 0.35
2. 2%= 0.02
3. 31%= 0.31
4. 95%= 0.95

Write each decimal as a percent. (Examples 4 and 5)

5. 0.22= 22%
6. 0.79= 79%
7. 0.1= 10%
8. 0.16= 16%

9. **Financial Literacy** A bank offers an interest rate of 4% on a savings account. Write 4% as a decimal. (Examples 1–3)
   0.04

10. When making a peanut butter and jelly sandwich, 96% of people put the butter on first. Write 96% as a decimal. (Examples 1–3)
    0.96

11. In a recent year, 0.12 of Emiratis downloaded a podcast from the Internet. What percent is equivalent to 0.12? (Example 6)
    12%

12. In a recent year, the number of homes with digital cameras grew 0.44 from the previous year. Write 0.44 as a percent. (Example 6)
    44%

13. **Financial Literacy** The formula $I = prt$ gives the simple interest I earned on an account where an amount p is deposited at an interest rate r for a certain number of years t. Use the table to order the accounts from least to greatest interest earned after 5 years.
    C: AED 59.50, A: AED 70, B: AED 87.50

Accounts at First Savings Bank		
Account	p (AED)	r (%)
A	350	4
B	500	3.5
C	280	4.25

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

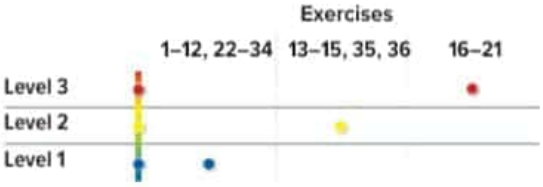
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–13, 15, 16, 18–21, 35, 36
OL	On Level	1–11 odd, 13–16, 18–21, 35, 36
BL	Beyond Level	13–21, 35, 36

Watch Out!

Common Error Remind students that they may have to ann zeros to properly place the decimal point when renaming percent as a decimal.

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	14, 17
2 Reason abstractly and quantitatively.	21
3 Construct viable arguments and critique the reasoning of others.	15, 19
4 Model with mathematics.	18, 20
6 Attend to precision.	34

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET
Out the Door

Have students explain the steps to writing a percent as a decimal and vice versa. Use the writing prompts below.

See students' work.

- To write a percent as a decimal, ...
- To write a decimal as a percent, ...

14. **Persevere with Problems** Emma wants to buy a coat that costs AED 80. The store that sells the coat has multiple locations. The sales tax in each county is shown in the table. How much more would the coat cost in Delaware county than Fairfield county?

County	Tax Rate (%)
Delaware	7.25
Fairfield	6.5
Franklin	6.75

AED 0.60

15. Fahd took three tests on Wednesday. He got a 92% on his English test, an 88% on his Math test and a 90% on his Science test. Write each percent as a decimal in order from least to greatest.
0.88, 0.90, 0.92

H.O.T. Problems Higher Order Thinking

16. **Reason Inductively** Write a decimal between 0.5 and 0.75. Then write it as a fraction in simplest form and as a percent.
Sample answer: $0.\frac{3}{5}$; 60%

17. **Persevere with Problems** How would you write $43\frac{3}{4}$% as a decimal?
Sample answer: Since $\frac{3}{4}$ is equal to 0.75, write $43\frac{3}{4}$% as 43.75%. Then change 43.75% to the decimal 0.4375.

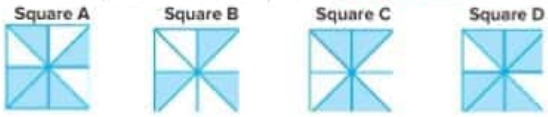
18. **Model with Mathematics** Write a percent between 25% and 50%. Then write it as a decimal and as a fraction in simplest form.
Sample answer: 26%; $0.\frac{13}{50}$;

19. **Reason Inductively** Explain why percents are rational numbers.
Sample answer: Every percent can be written as a fraction with a denominator of 100, and since every fraction is a rational number, every percent is a rational number.

20. **Model with Mathematics** Write a problem about a real-world situation in which you would either write a percent as a decimal or write a decimal as a percent.
Sample answer: Nasser scored a 92% on his math test. Express this percent as a decimal.

21. **Reason Abstractly** Each square below is divided into sections of equal size. In which square is 25% of the square shaded?
Square D

Square A | Square B | Square C | Square D



Name _____ My Homework _____

Extra Practice

Write each percent as a decimal.

22. 17% = 0.17
17% = 17/100 = 0.17

23. 3% = 0.03

24. 1% = 0.01

25. 11% = 0.11

Write each decimal as a percent.

26. 0.99 = 99%

27. 0.62 = 62%

28. 0.6 = 60%

29. 0.87 = 87%

30. In one day at a store, 7% of the sales were from shoes. Write 7% as a decimal.
0.07

31. In one hour on a certain street, 65% of the cars that passed were black. Write 65% as a decimal.
0.65

32. In a recent year, 0.57 of those registered to vote in France voted in an election. Write 0.57 as a percent.
57%

33. In a recent study, 0.82 of Germans own a cell phone. What percent is equivalent to 0.82?
82%

34. **Be Precise** In the United States, sales tax is added to items that you purchase. The rate of sales tax varies by state and sometimes by county or region. Use the table to order the counties from least to greatest sales tax.
County B, County A, County C

County Sales Tax	
County	Sales Tax
A	6.75%
B	0.0625
C	7/100

Power Up! Test Practice

Exercises 35 and 36 prepare students for more rigorous thinking needed for the assessment.

35.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practices	MP1, MP4
Scoring Rubric	
1 point	Students correctly answer each part of the question.

36.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK2
Mathematical Practices	MP1, MP6
Scoring Rubric	
2 points	Students correctly order the three counties AND identify the rate in each county.
1 point	Students correctly order the three counties but fail correctly to identify the rate OR students correctly identify 2 counties and correctly identify the rates in these two counties.

Power Up! Test Practice

35. At cricket practice, Majed caught 16 out of 20 hits to the outfield. Select all the ways of expressing 16 out of 20.

- ☐ $\frac{3}{5}$
- ■ 0.8
- ■ 80%
- ☐ 0.08

36. The Smith family wants to purchase a television that costs AED 449. The store that sells the television has multiple locations in different counties. The sales tax for each county is shown. Complete the table below by arranging the counties from least to greatest sales tax rate. Write each sales tax as a percent.

County	Tax Rate
Cuyahoga	$\frac{13}{200}$
Geauga	$\frac{13}{200}$
Lake	0.0675

	County	Sales Tax Rate (%)
Least	Geauga	6.5
	Lake	6.75
Greatest	Cuyahoga	7.75

Spiral Review

Fill in each ◯ with <, >, or = to make a true statement.

37. 2.50 = 2.5

38. 0.006 < 0.1

39. 0.015 > 0.005

40. The table shows results for the 100 meter sprint. Who was the fastest?

Majed

Athlete	Time (s)
Badr	12.14
Majed	11.84
Yasser	11.94
Jassim	12.44

41. Reham ate 0.75 sandwich. Her brother ate 1.5 sandwiches. Who ate more?

Reham's brother

Lesson 4

Percents Greater than 100% and Percents Less than 1%

Real-World Link

Plants There are over 220,000 species of plants on Earth. Of those, 590 are carnivorous. Plants such as a Venus Flytrap catch their prey as food.

1. Write the fraction of species of carnivorous plants in simplest form.

$\frac{590}{220{,}000} = \frac{590 \div 10}{220{,}000 \div 10} = \frac{59}{22{,}000}$

2. Write your answer to Exercise 1 as a decimal rounded to the nearest thousandth. Use division to find your answer.

$$\begin{array}{r} 0.0026 \\ 22000\overline{)59.0000} \\ -44\,000 \\ \hline 15\,0000 \\ -13\,2000 \\ \hline 1\,8000 \end{array}$$

$0.0026 \approx 0.003$

3. Write your answer to Exercise 2 as a fraction.

$\frac{3}{1{,}000}$

4. **Make a Conjecture** Since 0.3 = 30% and 0.03 = 3%, what percent is equal to 0.003? Explain.

0.3%; Sample answer: Since the decimal 0.03 is written as 3%, the decimal 0.003 is written as 0.3%.

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Mathematical Practices

1, 3, 4, 5

Which Mathematical Practices do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Write equivalent forms of fractions, decimals, and percents that are greater than 100% and less than 1%.

Coherence connecting within and across grades

Previous	Now	Next
Students wrote equivalent forms of percents and decimals.	Students write equivalent forms of fractions, decimals, and percents.	Students will compare and order fractions, decimals, and percents.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 121.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA Numbered Heads Together e students in groups of 3 or 4 work to complete Exercises 1–4 ensuring that each group member understands. Assign e student to a number. Call on one numbered student from group to explain each exercise to the class.

Alternate Strategy

AL Ask students to use number sense and estimation t verify that 590 out of 220,000 is about 0.3%, not 3%. For example, 590 out of 220,000 of 240,000. By dropping the common zeros, this becomes 6 of 2,400. One percen 2,400 is 24 and 6 is less than 24, so 6 of 2,400 is less th

MP 1, 3

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Write a percent less than 1% as a decimal and a fraction.

AL • *Is 0.2% less than or greater than 1%?* less than

• *Why do we divide by 100?* Percent means "per 100", which indicates division.

OL • *What is 0.2% written as a decimal?* 0.002

• *What is 0.002 in word form?* two thousandths

BL • *When dividing by 100, why do we move the decimal point two places to the left?* Each decimal place represents dividing by 10. So, dividing by 100 (10 × 10) the same result as moving the decimal point two places to the left.

Need Another Example?

Write 0.6% as a decimal and as a fraction in simplest form.

$0.006 = \frac{3}{500}$

2–3. Write a percent greater than 100% as a mixed number and a decimal.

AL • *In Example 2, will 170% equal a number greater than or less than 1?* greater than

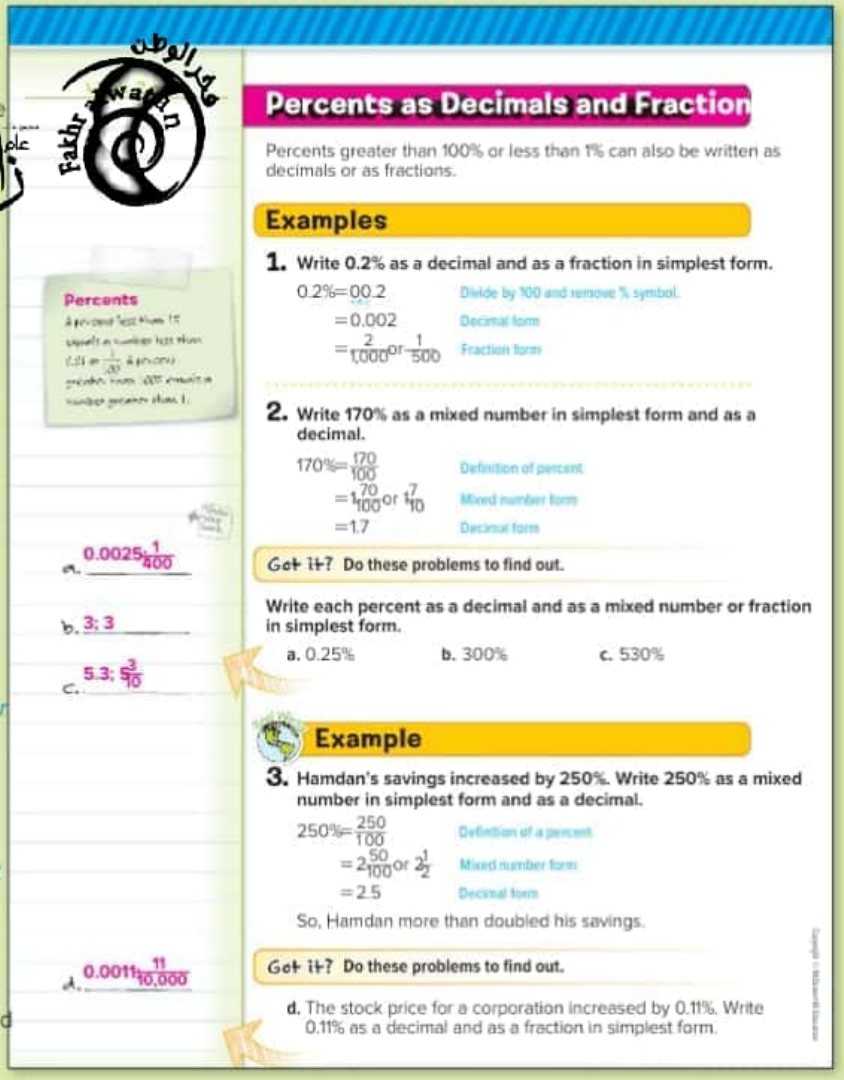
OL • *In Example 2, what is 170% expressed as a fraction with a denominator of 100? What mixed number, in simplest form, represents this fraction?* $\frac{170}{100}$; $1\frac{7}{10}$

BL • *Refer to Example 3. If Hamdan's account balance is now 3 times as much as it was originally, what percent would represent this number?* 300%

Need Other Examples?

a. Write 230% as a mixed number in simplest form and as a decimal. $2\frac{3}{10}$; 2.3

b. A company's profit increased by 110%. Write 110% as a mixed number in simplest form and as a decimal. $1\frac{1}{10}$; 1.1



Ratios and Proportional Relationships

Mixed Numbers and Decimals as Per

To write a decimal as a percent, multiply by 100 and add a percent sign. To write a mixed number as a percent, first write the mixed number as an improper fraction.

Example

4. Write $1\frac{1}{4}$ as a percent.

$1\frac{1}{4} = \frac{5}{4}$ Write $1\frac{1}{4}$ as an improper fraction.

$\frac{5}{4} = \frac{\blacksquare}{100}$ Find an equivalent fraction.

$\frac{5}{4} = \frac{125}{100}$ (×25) Since 4 × 25 = 100, multiply 5 by 25 to find an equivalent fraction.

So, $1\frac{1}{4}$ is $\frac{125}{100}$ or 125%.

Got it? Do these problems to find out.

Write each mixed number as a percent.

e. $2\frac{9}{10}$ f. $3\frac{2}{5}$

Examples

5. Write 1.68 as a percent.

1.68 = 1.68 Multiply by 100.
= 168% Add % symbol.

6. Write 0.0075 as a percent.

0.0075 = 0.0075 Multiply by 100.
= 0.75% Add % symbol.

Got it? Do these problems to find out.

g. 2.5 h. 0.004 i. 0.0016

Alternative Method

1 = 100%
$\frac{1}{4}$ = 25%
So, $1\frac{1}{4}$ = 125%.

e. 290%

f. 340%

Stop and Reflect

Is the decimal 6.7 equal to 670? Explain below.

No; Sample answer: The decimal 6.7 is equal to 670% when you multiply 6.7 × 100 and remove the percent sign.

g. 250%

h. 0.4%

i. 0.16%

Examples

4. Write a mixed number as a percent.

AL • *How do we write $1\frac{1}{4}$ as an improper fraction?* Think of 1 as $\frac{4}{4}$. Then add the like fractions $\frac{4}{4} + \frac{1}{4} = \frac{5}{4}$.

• *Will the percent be less than 100% or greater than 100%? Explain.* greater than; The mixed number is greater than 1, and 1 represents 100%.

OL • *How would you rewrite $\frac{5}{4}$ as a fraction with a denominator of 100?* Multiply the numerator and denominator by 25.

• *What is $\frac{1}{4}$ written as a percent?* 25%

BL • *What is another way you can write this mixed number as a percent?* Sample answer: The whole number 1 represents 100% and $\frac{1}{4}$ represents 25%; 100% + 25% = 125%.

Need Another Example?

Write $\frac{3}{5}$ as a percent. 160%

5–6. Write a decimal as a percent.

AL • *In Example 5, will the percent be less than 100% or greater than 100%? Explain.* greater than; The decimal is greater than 1. *Example 6?* less than; The decimal is less than 1.

OL • *In both examples, why do we multiply by 100?* Percent means "per 100". Since we have the decimal values, we need to multiply by 100 to find the percent.

• *How do we know that our answers are reasonable?* Sample answer: In Example 5, the percent should be greater than 100% but less than 200% because 1.68 is greater than 1, but less than 2. In Example 6, the percent should be less than 1% because the decimal is less than 0.01.

BL • *Is 0.75% equivalent to 0.75? Explain.* no; 0.75% = 0.0075

• *Give an example of a decimal whose percent equivalent is between 450% and 475%.* Sample answer: 4.65

Need Other Examples?

Write each decimal as a percent.

a. 1.09 109% **b.** 0.0008 0.08%

Example

7. Write a decimal as a percent.

AL • *What is the problem asking you to do?* Write 2.1 as a percent.

• *Which animal has the greater speed, the cheetah or the peregrine falcon?* peregrine falcon

OL • *What do you need to do to write a decimal as a percent?* Multiply by 100, which is the same as moving the decimal point two places to the right.

• *What is 2.1 write as a percent?* 210%

BL • *If a cheetah's speed is 70 miles per hour, what is a peregrine falcon's speed? How did you find this?* 147 mph; Multiply 70 by 2.1.

Need Another Example?
The smallest planet is Mercury. Its mass is about 0.00058 the mass of Saturn. Write this number as a percent. 0.058%

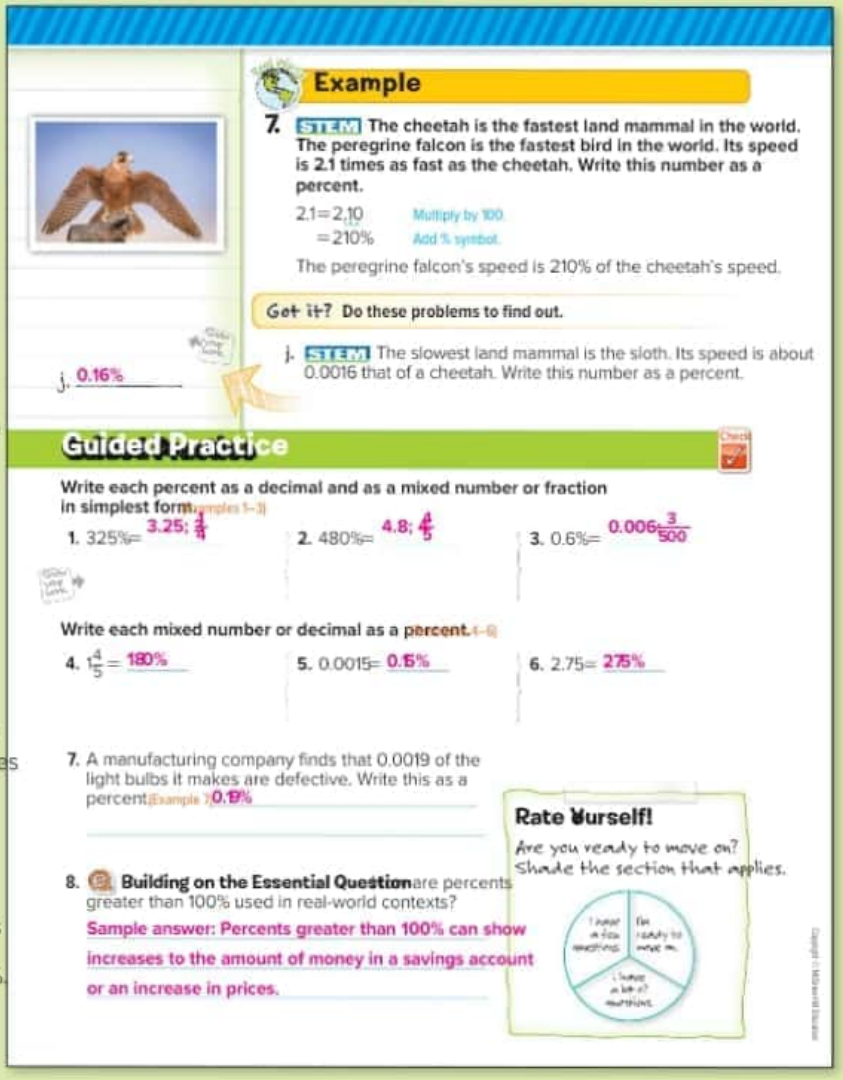
Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Team-Pair-Solo** Have students complete Exercises 1 and 4 as a small group, ensuring that each group member understands. Then have groups divide into pairs to complete Exercises 2, 5, and 7. Finally, have students complete Exercises 3, 6, and 8 individually. Have students return to their groups to compare solutions and discuss any results and differences.
MP 1, 3

BL LA **Trade-a-Problem** Ask students to write a real-world problem involving a percent greater than 100% or less than 1%, and trade with a partner to solve each other's problems. Ask them to discuss the kinds of situations that involve a percent greater than 100% or a percent less than 1%.
MP 1, 3, 4



Example

7. STEM The cheetah is the fastest land mammal in the world. The peregrine falcon is the fastest bird in the world. Its speed is 2.1 times as fast as the cheetah. Write this number as a percent.

$2.1 = 2.10$ Multiply by 100.
$= 210\%$ Add % symbol.

The peregrine falcon's speed is 210% of the cheetah's speed.

Got it? Do these problems to find out.

j. STEM The slowest land mammal is the sloth. Its speed is about 0.0016 that of a cheetah. Write this number as a percent. 0.16%

Guided Practice

Write each percent as a decimal and as a mixed number or fraction in simplest form. (Examples 1–3)

1. 325% = 3.25; $3\frac{1}{4}$
2. 480% = 4.8; $4\frac{4}{5}$
3. 0.6% = 0.006; $\frac{3}{500}$

Write each mixed number or decimal as a percent. (1–6)

4. $1\frac{4}{5}$ = 180%
5. 0.0015 = 0.15%
6. 2.75 = 275%

7. A manufacturing company finds that 0.0019 of the light bulbs it makes are defective. Write this as a percent. (Example 3) 0.19%

8. **Building on the Essential Question** What are percents greater than 100% used in real-world contexts?
Sample answer: Percents greater than 100% can show increases to the amount of money in a savings account or an increase in prices.

Rate Yourself!
Are you ready to move on? Shade the section that applies.

Name _____ My Homework _____

Independent Practice

Write each percent as a decimal and as a mixed number or fraction in simplest form. (Examples 1–3)

1. 350% = 3.5; $3\frac{1}{2}$
2. 600% = 6; 6
3. 0.15% = 0.0015; $\frac{3}{2{,}000}$
4. 0.55% = 0.0055; $\frac{11}{2{,}000}$

Write each mixed number as a percent. (Example 4)

5. $2\frac{1}{2}$ = 250%
6. $9\frac{3}{4}$ = 975%
7. $4\frac{1}{5}$ = 420%
8. $7\frac{3}{10}$ = 730%

Write each decimal as a percent. (Examples 5 and 6)

9. 8.5 = 850%
10. 2.64 = 264%
11. 0.009 = 0.9%
12. 0.0034 = 0.34%

13. The size of a large milkshake is 1.4 times the size of a medium milkshake. Write 1.4 as a percent. (Example 7)
    140%

14. STEM Fresh water from lakes accounts for only 0.001 of the world's water supply. Write this decimal as a percent. (Example 7)
    0.1%

15. In a recent year, the United States Census Bureau reported that 0.3% of the population in the United States was Japanese. Write this percent as a decimal and as a fraction. Then interpret its meaning as a ratio of the United States population.
    0.003; $\frac{3}{1{,}000}$; 3 out of every 1,000 people are Japanese.

16. Yasmin answered all 21 multiple-choice questions correctly on her science test. If her teacher decided to let one of the questions count as a bonus, worth the same number of points as the other problems on the test, what was Yasmin's test score? Write your answer as a decimal and as a percent.
    1.05; 105%

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

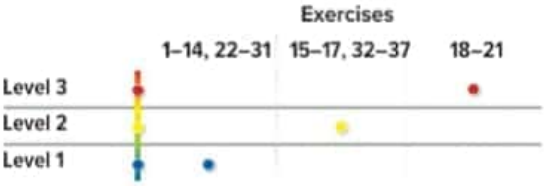
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignme

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Leve indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–15, 17, 18, 20, 21, 36, 37
OL	On Level	1–13 odd, 15–18, 20, 21, 36, 37
BL	Beyond Level	15 [illegible] 37

Watch Out!

Common Error Remind students that rewriting percents as decimals means dividing by 100 and results in moving the decimal two places to the left. Rewriting decimals as perc means multiplying by 100 and results in moving the decim two places to the right.

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	19
3 Construct viable arguments and critique the reasoning of others.	18, 21
4 Model with mathematics.	20
5 Use appropriate tools strategically.	17, 34, 35

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Have students write 112% as a decimal and as a mixed number in simplest form. 1.12; $1\frac{3}{25}$

17. **Use Math Tools** Refer to the table at the right.
a. Write the percent of magnesium found in the human body as a decimal.
0.0005

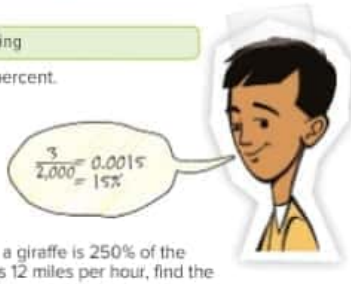
b. Which element makes up $\frac{1}{400}$ of the human body?
sulfur

Elements in the Human Body

Element	Percent
Magnesium	0.05
Potassium	0.35
Sodium	0.15
Sulfur	0.25

H.O.T. Problems Higher Order Thinking

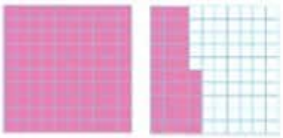
18. **Find the Error** Ismail is writing $\frac{3}{2,000}$ as a percent. Find his mistake and correct it.
Ismail multiplied by 10,000 when he changed the decimal to a percent. $\frac{3}{2,000} = 0.0015 = 0.15\%$



19. **Persevere with Problems** The speed of a giraffe is 250% of the speed of a squirrel. If a squirrel's speed is 12 miles per hour, find the speed of a giraffe.
30 mph

20. **Model with Mathematics** Write a real-world problem involving a percent greater than 100%. Then solve the problem.
Sample answer: Obaid's new salary is 110% of his previous salary. What is this percent as a decimal? 1.10

21. **Reason Inductively** Explain how you would show 135% on a 10-by-10 grid. Then use the grids below to show your answer.
Sample answer: Since 135% > 100%, two 10-by-10 grids will be used. The first will be completely shaded and the second will have 35 of the sections shaded.



Name _____ My Homework _____

Extra Practice

Write each percent as a decimal and as a mixed number or fraction in simplest form.

22. 475% = 4.75; $4\frac{3}{4}$

$475\% = \frac{475}{100}$

$= 4\frac{75}{100}$ or $4\frac{3}{4}$

$= 4.75$

23. 400% = 4; 4

24. 0.05% = $\frac{0.0005}{2{,}000}$ or $\frac{1}{2{,}000}$

25. 0.04% = $\frac{0.0004}{2{,}500}$ or $\frac{1}{2{,}500}$

Write each decimal as a percent.

26. 1.07 = 107%

27. 35 = 3,500%

28. 0.003 = 0.3%

29. 0.0077 = 0.77%

30. A collectible action figure sold for 193% of its original price. Write this percent as a decimal and as a mixed number or fraction in simplest form.

1.93; $1\frac{93}{100}$

31. A car's tire pressure decreased by 0.098 of its original pressure. Write 0.098 as a percent.

9.8%

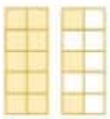
Write each percent as a decimal.

32. $\frac{3}{4}\% = 0.0075$

33. $\frac{3}{25}\% = 0.0012$

Use Math Tools One complete figure represents 100%. Write a percent to represent the shaded portion of each figure below.

34. 130%



35. 125%

Power Up! Test Practice

Exercises 36 and 37 prepare students for more rigorous thinking needed for the assessment.

36.

This test item requires students to analyze and solve complex real-world problems through the use of mathematical tools and models.	
Depth of Knowledge	DOK2
Mathematical Practices	MP4, MP6
Scoring Rubric	
1 point	Students correctly shade 7 pieces of the diagram.

37.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP7
Scoring Rubric	
2 points	Students select both correct answers AND write $\frac{9}{25,000}$ in the box.
1 point	Students select both correct answers OR write $\frac{9}{25,000}$ in the box.

Power Up! Test Practice

36. Shade the model to show 140%.

37. About 0.036% of the water on Earth is found in lakes and rivers. Which of the following show 0.036% written as a fraction? Select all that apply.

- ☐ $\frac{9}{25}$
- ☐ $\frac{36}{100}$
- ■ $\frac{18}{50,000}$
- ■ $\frac{27}{75,000}$

What is 0.036% written as a fraction in simplest form? $\frac{9}{25,000}$

Spiral Review

Compare the fractions using >, or =.

38. $\frac{3}{6} > \frac{1}{8}$

39. $\frac{10}{17} < \frac{11}{12}$

40. $\frac{7}{9} > \frac{5}{11}$

41. Moza walked $\frac{3}{10}$ of a kilometer on Monday, $\frac{5}{10}$ of a kilometer on Tuesday, and $\frac{25}{100}$ of a kilometer on Wednesday. Plot each distance on the number line.

42. The flute players are $\frac{3}{10}$ of the band and the trumpet players are $\frac{1}{12}$ of the band. Is a greater fraction of the band flute players or trumpet players?

flute players

MP Problem-Solving Investigation

Solve a Simpler Problem

MP Mathematical Practices 1, 3, 4

Case #1 First Place Pizza

The daily lunch report indicated that 80% of the 300 students at a Dubai Middle School chose pizza for lunch.

How many students bought pizza for lunch?

1 Understand *What are the facts?*

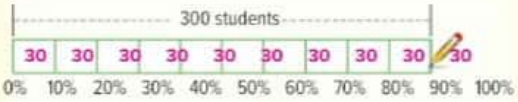
- The lunch report says 80% chose pizza.
- There are 300 students at the school.

2 Plan *What is your strategy to solve this problem?*

Solve a simpler problem by finding 10% of the total students. Then use the result to find 80% of the total students.

3 Solve *How can you apply the strategy?*

Complete the bar diagram. Fill in the value of each section.



There are 30 10, or 10 groups with 30 students in each group.

Multiply. 30 × 8 = 240

So, 240 students chose pizza for lunch.

4 Check *Does the answer make sense?*

You know that 80% is close to 75%, which is $\frac{3}{4}$. Since $\frac{1}{4}$ of 300 is 75, $\frac{3}{4}$ of 300 is 225. So, my answer is reasonable.

Analyze the Strategy

MP Reason Inductively Explain when you would use the *a simpler problem* strategy. Sample answer: Use this strategy when there is a way to solve the problem using simpler numbers.

Focus narrowing the scope

Objective Solve problems by solving a simpler problem. This lesson emphasizes **Mathematical Practice 3** Construct an Argument.

Solve a Simpler Problem Sometimes it is helpful to break a complex problem down to solve a simpler one. Doing this involve doing one step of the problem, using smaller numb or rounding numbers.

Coherence connecting within and across grades

Now Students solve non-routine problems.

Next Students will apply the solve a simpler problem strategy to solve problems.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 127.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

The problems on pages 125 and 126 are intended to be u as a whole-group discussion on how to solve non-routine problems and are designed to provide scaffolded guidanc

Case #1 First Place Pizza

BL Extend the problem by asking the questions below.

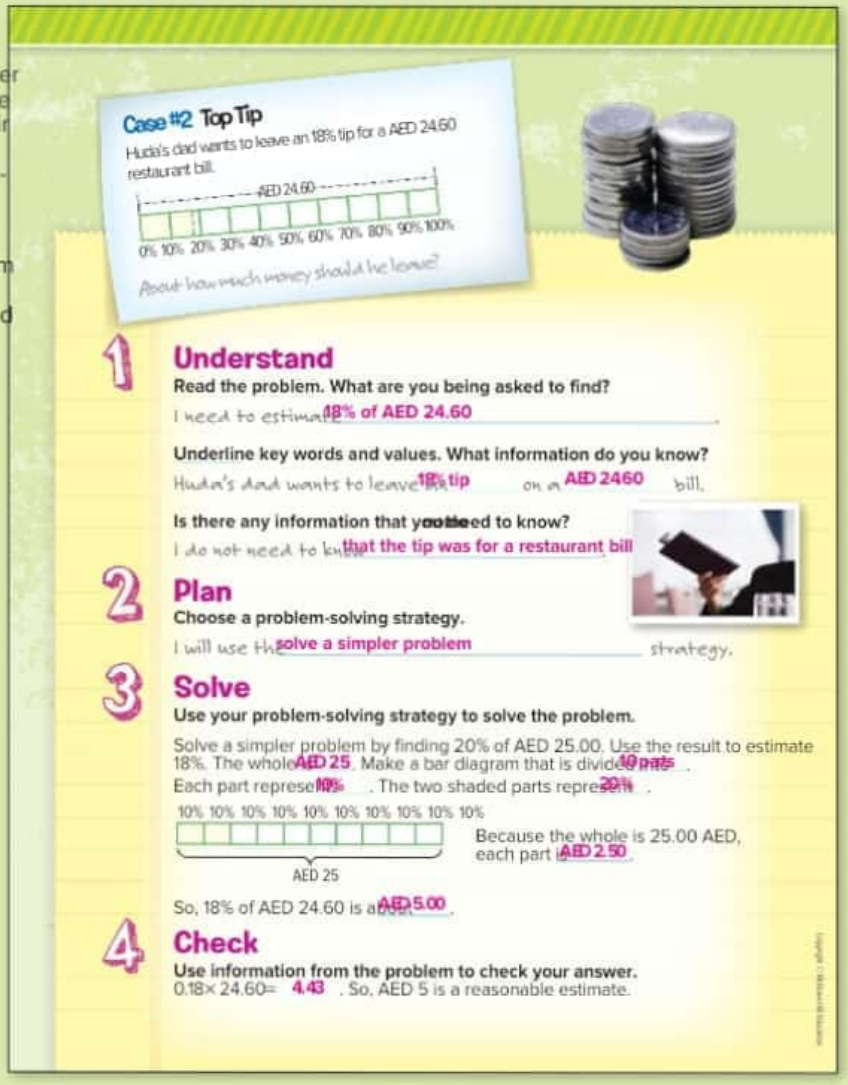
- *How could you use this strategy if the problem asked h many students did not choose pizza?* Sample answer: Since 80% chose pizza, 20% did not choose pizza. I can still find 10 the students, 30, and multiply by 2 to find that 60 students d not choose pizza.
- *Is there another way you can find how many students d not choose pizza?* Sample answer: I can find the number of students that chose pizza and subtract that number from 300.

Case #2 Top Tip

AL LA Paired Heads Together Have students solve the problem individually. Then have students pair up with a partner and share their answers. If either answer is incorrect, have the students alternate to go back through the steps to check their answers. For example, one student completes the odd-numbered steps, while the other student completes the even-numbered steps. MP 1, 3, 7

BL LA Trade-a-Problem Have students work in pairs to solve the problem. Then have them write a real-world problem that is similar to *Top Tip*. Students trade their problem and solve. Give them time to discuss and correct any mistakes and information. MP 1, 3, 4

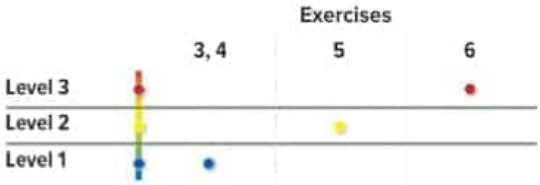
Need Another Example?
The Wildcats scored 380 baskets in their last basketball season. If 15% of the baskets were free throws, how many baskets did they make on free throws? 57 baskets



2 Collaborate

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level 1 indicating the lowest level of complexity.



AL LA **Teammates Consult** Have students in teams of four to complete Cases 3–6. Each student is given a number 3–6, which represents the case discussion they are leading. Teammates discuss the first case with Student 1 leading the discussion. All members of the team contribute, but all have to agree upon one answer. Continue by rotating the leader role until all the cases are completed. MP.3

BL LA **Pairs Discussion** Have students choose one of the cases and write an extension of that problem. For example, in Case 4, students may choose to find how many numbers from 10 to 5,000 are palindromes. Have them discuss with a partner how solving a simpler problem helps them solve their extension problem. MP.1, 3, 4

Work with a small group to solve the following cases. Show your work on a separate piece of paper.

Case #3 Time

Three 24-hour clocks show the time to be 12 noon. One of the clocks is always correct, one loses a minute every 24 hours, and one gains a minute every 24 hours.

How many days will pass before all three clocks show the correct time again?

1,440 days

Case #4 Number Sense

The number 272 is a palindrome because it reads the same forward or backward.

How many numbers from 10 to 1,000 are palindromes?

99 numbers

Case #5 Sandwiches

In one day, a restaurant made the sandwiches shown in the table.

Type	Number	Percent
Veggie	60	5
Cheese	204	17
Turkey	348	29
Chicken	?	35
Roast Beef	168	14

How many sandwiches were chicken?

420 sandwiches

Case #6 Border

Part of a strip of border for a bulletin board is shown. All of the sections of the border are the same width.

If the first shape on the strip is a triangle and the strip is 74 cm long, what is the last shape on the strip?

circle

Use any strategy!

Mid-Chapter Check

If students have trouble with Exercises 1–10, they may need help with the following concepts.

Concept	Exercise(s)
fractions and decimals (Lesson 1)	2, 3, 4
percents and decimals (Lessons 3 and 4)	5–9
percents and fractions (Lesson 2)	1, 9, 10

Vocabulary Activity

LA Numbered Heads Together Have students work in a small group to complete Exercise 1. Each student is assigned a number. Students are responsible for ensuring that each group member understands the meaning of a percent. Students should ask each other for clarification and assistance, as needed. Call on one numbered student to share their definition with the class. MP 3, 6

Alternate Strategies

AL LA Have students break apart the term *percent* into two words that help them remember what the term means. Then have them use a 10×10 grid or bar diagram to model the fraction given in Exercise 1 in order to help them write the fraction as a percent and as a decimal. MP 5, 6

BL Have students verbally explain the difference between 0.3% and 3%. MP 1, 3

Mid-Chapter Check

Vocabulary Check

1. Define *percent*. Write $\frac{25}{100}$ as a percent then write $\frac{25}{100}$ as a decimal. (Lesson 2)

A percent is a ratio that compares a number to 100. 25%; 0.25

Skills Check and Problem Solving

Write each fraction as a decimal and each decimal as a fraction in simplest form. (Lesson 1)

2. $\frac{8}{20}$ = 0.4
3. 0.64 = $\frac{16}{25}$
4. $\frac{3}{100}$ = 0.03

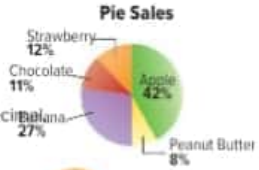
Write each percent as a decimal and each decimal as a percent. (Lesson 4)

5. 73% = 0.73
6. 0.1 = 10%
7. 254% = 2.54

8. The number of chorus students increased by a factor of 1.2 from the previous year. Write 1.2 as a percent. (Lesson 3)

120%

9. **Use Math Tools** The graph shows the pie sales during one week for Alnood's Pies. (Lessons 2 and 3)



a. What fraction of the pies sold was apple?

$\frac{21}{50}$

b. Write the percent of strawberry pies sold as a decimal.

0.12

10. **Persevere with Problems** The circle at the right is divided into sections of equal size. What percent of the circle is not shaded? (Lesson 2)

25%

Lesson 5

Compare and Order Fractions, Decimals, and Percents

Vocabulary Start-Up

The **least common denominator**, LCD, is the least common multiple of the denominators of two or more fractions.

Complete the graphic organizer. Write the meaning of each word in the appropriate box. Provide examples. Sample answers are given.

Least	Common
the smallest of a set of values; Of the numbers 3, 4, and 5, 3 is the least in value.	the usual; often seen; It is common for Maya to receive an A in math class.
least common denominator	
Denominator	**multiple**
the bottom number in a fraction; It represents the number of parts in the whole. In $\frac{5}{6}$, the denominator is 6.	A multiple of a number is the product of that number and any whole number. 15 is a multiple of 3 because $3 \cdot 5 = 15$.

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Vocabulary

least common denominator (LCD)

Mathematical Practices

1, 2, 3, 4, 5, 6

Real-World Link

- Humaid is baking, but he wants to use only one measuring cup. He needs $\frac{1}{2}$ cup of sugar and $\frac{3}{4}$ cup of flour. What is the least common multiple of the denominators? 4
- What size measuring cup should he use: $\frac{1}{2}$ cup, $\frac{1}{3}$ cup, or $\frac{1}{4}$ cup? Explain. He should use the $\frac{1}{4}$ cup measuring cup because the least common denominator of $\frac{1}{2}$ and $\frac{3}{4}$ is 4 and the fraction $\frac{1}{4}$ has a denominator of 4.

Which Mathematical Practices do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Compare and order fractions, decimals, and percents.

Coherence connecting within and across grades

Previous	Now	Next
Students wrote equivalent forms of fractions, decimals, and percents.	Students compare and order fractions, decimals, and percents.	Students will use estimation to find the percent of a number.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 133.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, small group, think-pair-share activity, or independent activity.

LA **Numbered Heads Together** Assign students to 3- or 4-person learning teams. Each member is assigned a number from 1 to 4. Each team completes the graphic organizer and Real-World Link, making sure that each member understands each of the four entries. Call on a specific number from a team to present the team's solution to the class. MP 1, 5

Alternate Strategy

AL If students are having difficulty, remind them that they can always find a common multiple for the denominator by multiplying the denominators together. However, that number isn't necessarily going to be the least common denominator.

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions to differentiate instruction.

Examples

1. Compare fractions.

AL • *Do the two fractions have the same denominator?* no

• *Can you just compare the numerators to determine which fraction is greater? Explain.* no; Sample answer: The fractions have different denominators. Just because 7 is greater than 5 does not necessarily mean that 7 out of 12 is a greater fraction than 5 out of 8.

OL • *What do you need to do to be able to easily compare* $\frac{5}{8}$ *and* $\frac{7}{12}$*?* Find the LCD of the fractions, and then rewrite each fraction using the LCD.

• *What is the LCD of 8 and 12?* 24

• *What are the fractions rewritten with the LCD?* $\frac{15}{24}$ and $\frac{14}{24}$

BL • *Is there another denominator you could use? Explain.* Yes; 24 is the least common denominator, but you could use any multiple of 24 as a denominator.

Need Another Example?

Is $\frac{8}{21}$ less than, greater than, or equal to $\frac{6}{14}$? less than

2. Order fractions.

AL • *What must be done first to be able to order the fractions?* Rewrite each fraction using the LCD.

OL • *What is the LCD?* 28

• *What are the fractions rewritten with a denominator of 28?* $\frac{14}{28}, \frac{18}{28}, \frac{21}{28}, \frac{20}{28}$

BL • *What is the last step in ordering the fractions?* Compare the numerators to put them in order from least to greatest.

Need Another Example?

Order the fractions $\frac{2}{3}, \frac{4}{5}, \frac{8}{15}$, and $\frac{3}{5}$ from least to greatest. $\frac{8}{15}, \frac{3}{5}, \frac{2}{3}, \frac{4}{5}$

Work Zone

Least Common Multiple

Compare and Order Fractions

To compare fractions, you can follow these steps.

1. Find the least common denominator (LCD) of the fractions. That is, find the least common multiple of the denominators.
2. Write an equivalent fraction for each fraction using the LCD.
3. Compare the numerators.

Example

Fill in each ◯ with <, >, or = to make a true statement.

1. $\frac{5}{8} \bigcirc \frac{7}{12}$

The LCM of the denominators, 8 and 12, is 24. So, the LCD is 24. Write an equivalent fraction with a denominator of 24 for each fraction. $\frac{5}{8} = \frac{15}{24}$ (×3) $\frac{7}{12} = \frac{14}{24}$ (×2)

$\frac{15}{24} > \frac{14}{24}$ since 15 > 14. So $\frac{5}{8} > \frac{7}{12}$.

Got it? Do these problems to find out.

a. $\frac{2}{3} > \frac{4}{9}$ b. $\frac{5}{12} < \frac{7}{8}$ c. $\frac{1}{6} < \frac{5}{18}$

Example

2. Order the fractions $\frac{1}{2}, \frac{9}{14}, \frac{3}{4}$ and $\frac{5}{7}$ from least to greatest.

Rewrite each fraction using the LCD of 28.

$\frac{1}{2} = \frac{14}{28}$ (×14) $\frac{9}{14} = \frac{18}{28}$ (×2) $\frac{3}{4} = \frac{21}{28}$ (×7) $\frac{5}{7} = \frac{20}{28}$ (×4)

Since $\frac{14}{28} < \frac{18}{28} < \frac{20}{28} < \frac{21}{28}$, the order of the original fractions from least to greatest is $\frac{1}{2}, \frac{9}{14}, \frac{5}{7}, \frac{3}{4}$.

Got it? Do these problems to find out.

d. Order $\frac{1}{2}, \frac{5}{6}, \frac{2}{3}$ and $\frac{3}{5}$ from least to greatest.

A. $\frac{1}{2}, \frac{3}{5}, \frac{2}{3}, \frac{5}{6}$

Compare Fractions, Decimals, and Per

It may be easier to compare fractions, decimals, and percents when they are all written as decimals.

$\frac{1}{5}=0.2=20\%$	$\frac{2}{5}=0.4=40\%$	$\frac{3}{5}=0.6=60\%$	$\frac{4}{5}=0.8=80\%$
$\frac{1}{8}=0.125=12.5\%$	$\frac{3}{8}=0.375=37.5\%$	$\frac{1}{3}=0.\overline{3}=33.\overline{3}\%$	$\frac{2}{3}=0.\overline{6}=66.\overline{6}\%$

Examples

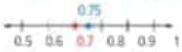
Fill in each ◯ with <, >, or = to make a true statement.

3. $\frac{3}{4}$ ◯ 0.7

$\frac{3}{4}$ ◯ 0.7 — Write the sentence.

0.75 ◯ 0.70 — Write $\frac{3}{4}$ as a decimal. Annex a zero to 0.7.

0.75 > 0.70 — Compare the hundredths place: 5 > 0



Since 0.75 is to the right of 0.7 on the number line, $\frac{3}{4} > 0.7$.

4. Nawar made 85% of her free throws. Hind made $\frac{7}{8}$ of her free throws. Who has the better average? Explain.

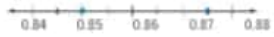
85% ◯ $\frac{7}{8}$ — Write the sentence.

0.850 ◯ 0.875 — Write each number as a decimal. Annex a zero to 0.85.

0.850 < 0.875 — Compare the hundredths place: 5 < 7

Since 0.850 < 0.875, Hind has the better average.

Check



Since 0.85 is to the left of 0.875, the answer is correct.

Got it? Do these problems to find out.

e. $\frac{2}{3}$ > 0.6 f. 0.7 < $\frac{8}{11}$ g. $\frac{1}{5}$ = 0.2

h. 42% < 0.44 i. 7% < $\frac{7}{10}$ j. 6.5 = 650%

Examples

3. Compare fractions and decimals.

AL
- *Are the numbers written in the same form?* no
- *What must you do to compare the two numbers?* Write them in the same form.

OL
- *How do you write $\frac{3}{4}$ as a decimal?* Divide 3 by 4.
- *Is 0.75 greater than or less than 0.7?* greater

BL
- *Is it easier to write $\frac{3}{4}$ as a decimal than to write 0.7 as a fraction in order to compare the two? Explain.* Sample answer: Yes; decimals are easier to compare since their "denominators" are multiples of 10.

Need Another Example?

Is $\frac{2}{5}$ less than, greater than, or equal to 0.2? greater than

4. Compare rational numbers.

AL
- *Are the numbers written in the same form?* no
- *What must you do to compare the two numbers?* Write them in the same form.

OL
- *How do you write $\frac{7}{8}$ as a decimal?* Divide 7 by 8.
- *Why do we annex a zero to 0.85?* so that both numbers have the same number of decimal places for easier comparison
- *Is 0.850 greater than or less than 0.875?* less than

BL
- *Could you have written both numbers as fractions and then compared the fractions? Explain.* Yes; Sample answer: Writing both numbers as fractions and then comparing the fractions is a valid method because the fractions would be equivalent forms of the numbers.
- *If you wrote both numbers as fractions, what would be an additional step that you may have to do?* I may have to find the LCD and rewrite both fractions so that they have the same denominator in order to compare the fractions.

Need Another Example?

At Games Plus, 35% of the games are board games. At More Games, $\frac{3}{8}$ of the games are board games. Which store has a greater portion of board games? More Games

Example

5. Order rational numbers.

AL • *Are the numbers written in the same form?* no

• *What must you do to find the greatest number?* Write the numbers in the same form. Then order the numbers.

OL • *What is each value written as a decimal?* $\frac{5}{8}$ = 0.625; 0.5 = 0.500; 58.3% = 0.583

BL • *How does using a number line help to determine the greatest number?* Sample answer: The number farthest to the right is the greatest number.

Need Another Example?
The table shows tryouts for the school volleyball team. Which grade had the least portion of students trying out for the team? Grade 6

Grade	Tryouts
6	$\frac{1}{4}$
7	35%
8	0.4

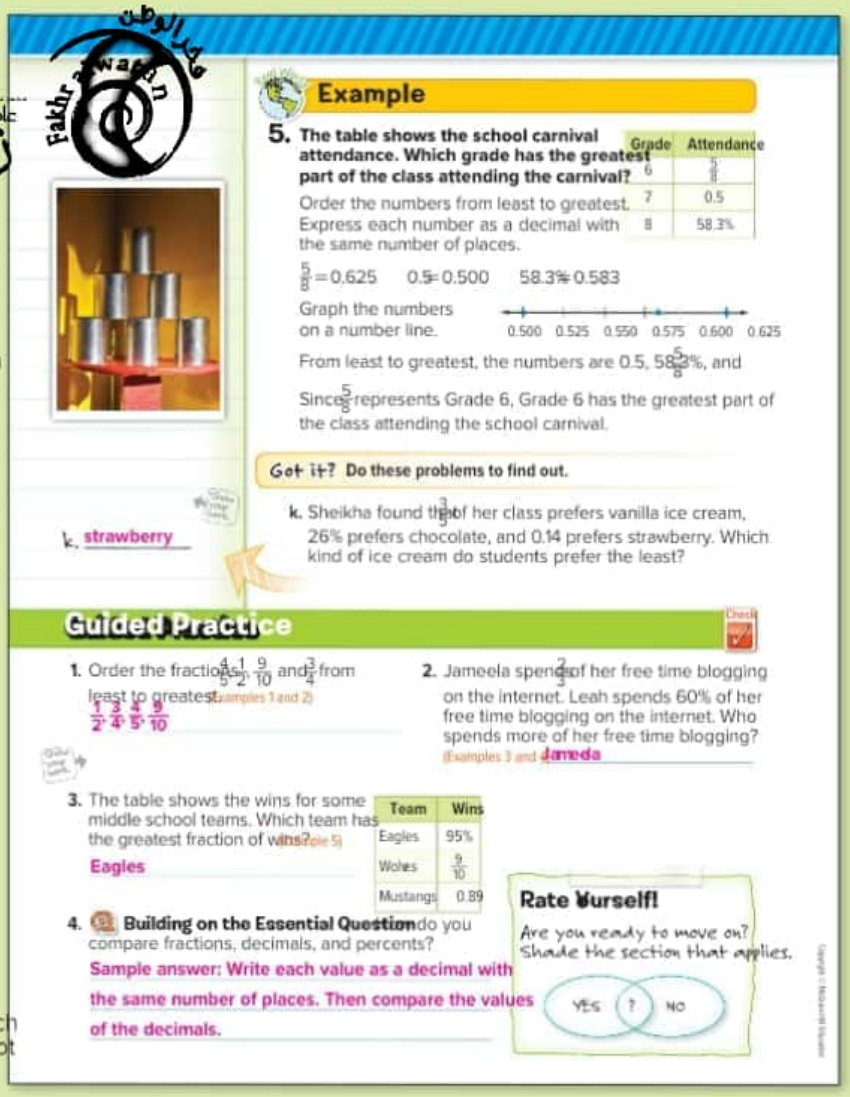
Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Think-Pair-Share** Have students work in pairs. Give students one minute to think through their responses to Exercises 1–4. Have them share their responses with their partner. Then call on one student to share their responses within a small group or large group discussion.

BL LA **Trade-a-Problem** Each student creates a problem to be solved that involves three or more different numbers similar to Exercise 2. Students trade their problems, solve each other's problem, and compare solutions. If the solutions do not agree, students work together to find the error.



Example

5. **The table shows the school carnival attendance. Which grade has the greatest part of the class attending the carnival?**

Grade	Attendance
6	$\frac{5}{8}$
7	0.5
8	58.3%

Order the numbers from least to greatest. Express each number as a decimal with the same number of places.

$\frac{5}{8}$ = 0.625 0.5 = 0.500 58.3% = 0.583

Graph the numbers on a number line.

0.500 0.525 0.550 0.575 0.600 0.625

From least to greatest, the numbers are 0.5, 58.3%, and $\frac{5}{8}$.

Since $\frac{5}{8}$ represents Grade 6, Grade 6 has the greatest part of the class attending the school carnival.

Got it? Do these problems to find out.

k. Sheikha found that $\frac{3}{8}$ of her class prefers vanilla ice cream, 26% prefers chocolate, and 0.14 prefers strawberry. Which kind of ice cream do students prefer the least?

k. strawberry

Guided Practice

1. Order the fractions $\frac{4}{5}$, $\frac{1}{2}$, $\frac{9}{10}$, and $\frac{3}{4}$ from least to greatest. (Examples 1 and 2) $\frac{1}{2}, \frac{3}{4}, \frac{4}{5}, \frac{9}{10}$

2. Jameela spends $\frac{2}{3}$ of her free time blogging on the internet. Leah spends 60% of her free time blogging on the internet. Who spends more of her free time blogging? (Examples 3 and 4) Jameela

3. The table shows the wins for some middle school teams. Which team has the greatest fraction of wins? (Example 5) Eagles

Team	Wins
Eagles	95%
Wolves	$\frac{9}{10}$
Mustangs	0.89

4. **Building on the Essential Question** How do you compare fractions, decimals, and percents? Sample answer: Write each value as a decimal with the same number of places. Then compare the values of the decimals.

Rate Yourself!
Are you ready to move on? Shade the section that applies.

YES ? NO

Name _____ My Homework _____

Independent Practice

Fill in each ○ with <, >, or = to make a true statement. (Examples 1 and 3)

1. $\frac{1}{3}$ ○ $\frac{3}{5}$ — $\frac{1}{3} < \frac{3}{5}$
2. $\frac{7}{12}$ ○ $\frac{1}{2}$ — $\frac{7}{12} > \frac{1}{2}$
3. $\frac{1}{4}$ ○ 0.4 — $\frac{1}{4} < 0.4$
4. 0.7 ○ $\frac{7}{9}$ — $0.7 < \frac{7}{9}$

Order the fractions from least to greatest. (2)

5. $\frac{1}{2}, \frac{2}{3}, \frac{1}{3}, \frac{5}{6}$ — $\frac{1}{3}, \frac{1}{2}, \frac{2}{3}, \frac{5}{6}$
6. $\frac{2}{3}, \frac{2}{5}, \frac{5}{6}, \frac{11}{18}$ — $\frac{2}{5}, \frac{11}{18}, \frac{2}{3}, \frac{5}{6}$

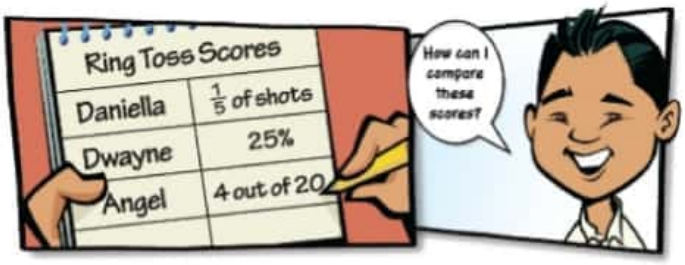
7. Kareem spends 35% of his time doing math homework. Ayoub spends $\frac{2}{5}$ of his time doing math homework. Who spends more time doing math homework? Explain. (Example 4)

   Ayoub; $0.35 < 0.40$

8. Three snack bars contain $\frac{1}{9}$, 0.22, and 19% of their calories from fat. Which snack bar contains the least amount of calories from fat? (Example 5)

   the snack bar with 19% calories from fat

9. **Model with Mathematics** Use the graphic novel frame below for Exercises a–b.



a. Write each score as a decimal. 0.20, 0.25, 0.20

b. Compare the three scores. Two are the same; 0.25 is the greatest score.

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

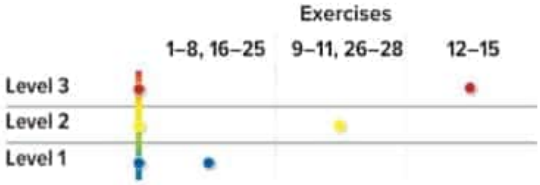
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–9, 11, 12, 15, 27, 28
OL	On Level	1–7 odd, 9–12, 15, 27, 28
BL	Beyond Level	9–15, 27, 28

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	13, 14
2 Reason abstractly and quantitatively.	12
3 Construct viable arguments and critique the reasoning of others.	15
4 Model with mathematics.	9
5 Use appropriate tools strategically.	26
6 Attend to precision.	10

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Ask students to order 60%, and 0.62 from least to greatest. 60%, 0.62, $\frac{5}{8}$

10. **Be Precise** Complete the graphic organizer. Write the original numbers to complete the statement.

Number	Decimal
$\frac{3}{8}$ Divide the numerator by the denominator	0.375
0.3 The number is a decimal. Annex two zeros.	0.300
38.7% Move the decimal point two places to the left. Remove the percent symbol.	0.387

So, 0.3 < $\frac{3}{8}$ < 38.7%.

11. Order the portion of responses listed in the table from least to greatest.
8%, 17%, 0.2, $\frac{21}{20}$

Number of Times Eating Fast Food per Week	0	1–2	3–4	5
Portion of Responses	17%	$\frac{21}{20}$	0.2	8%

H.O.T. Problems Higher Order Thinking

12. **Reason Abstractly** Specify three fractions with different denominators that have an LCD of 24. Then arrange the fractions in order from least to greatest.
Sample answer: $\frac{3}{8}, \frac{2}{3}, \frac{5}{6}$

13. **Persevere with Problems** Order $\frac{3}{8}, \frac{3}{7}$, and $\frac{3}{9}$ from least to greatest without writing equivalent fractions with a common denominator. Explain your strategy. $\frac{3}{9}, \frac{3}{8}$, and $\frac{3}{7}$; Because the numerators are the same, the larger the denominator, the smaller the fraction.

14. **Persevere with Problems** Are the fractions $\frac{3}{9}, \frac{3}{10}, \frac{3}{11}$, and $\frac{3}{12}$ arranged in order from least to greatest or from greatest to least? Explain.
greatest to least; Sample answer: When fractions have the same numerator, the fraction with the larger denominator will be the smaller fraction.

15. **Construct an Argument** Is 0.4 less than, greater than, or equal to 44%? Explain your reasoning.
less than; Sample answer: 0.4 is equivalent to 0.40, and 44% is equivalent to 0.44. Zero is less than 4 when you compare the hundredths.

Name _____ My Homework _____

Extra Practice

Fill in each ◯ with <, >, or = to make a true statement.

16. $\frac{7}{8} \bigcirc \frac{5}{6}$ — Homework Help: $\frac{7}{8} = \frac{21}{24}, \frac{5}{6} = \frac{20}{24}$; $\frac{21}{24} > \frac{20}{24}$ so $\frac{7}{8} > \frac{5}{6}$

17. $\frac{14}{18} \bigcirc \frac{7}{9}$

18. $0.75 \bigcirc \frac{1}{2}$

19. $\frac{1}{3} \bigcirc 0.33$

Order the fractions from least to greatest.

20. $\frac{1}{6}, \frac{2}{5}, \frac{3}{7}, \frac{3}{5}$

$\frac{1}{6}, \frac{2}{5}, \frac{3}{7}, \frac{3}{5}$

21. $\frac{5}{8}, \frac{3}{4}, \frac{1}{2}, \frac{9}{16}$

$\frac{1}{2}, \frac{9}{16}, \frac{5}{8}, \frac{3}{4}$

22. Shop Rite has jeans on sale for $\frac{3}{10}$ off. Save More has jeans on sale for 33% off. Which store has a better sale on jeans? Explain.

Save More; 0.30<0.33

23. A city's population rose by 3% one year, by 0.08 the next year, and by $\frac{2}{50}$ the next year. Order these increases from least to greatest.

3%, $\frac{2}{50}$, 0.08

Order each set of values from least to greatest.

24. $0.4, \frac{5}{8}$, 38%

38%, $0.4, \frac{5}{8}$

25. $\frac{1}{2}$, 0.55, $\frac{5}{7}$

$\frac{1}{2}$, 0.55, $\frac{5}{7}$

26. **Use Math Tools** The table shows the favorite subjects of students in a recent survey.

Favorite Subject	
Subject	Portion of Students
Art	$\frac{4}{25}$
English	13%
Math	0.28
Other	7%
Science	$\frac{21}{100}$
Social Studies	0.15

a. Did more students choose Art or Math? Explain.

Math; $0.28 > \frac{4}{25}$

b. Which subject did most students choose? Explain.

Math; 0.28 is greater than other values in the table.

c. Order the subjects from least to greatest.

other, English, Social Studies, Art, Science, Math

Power Up! Test Practice

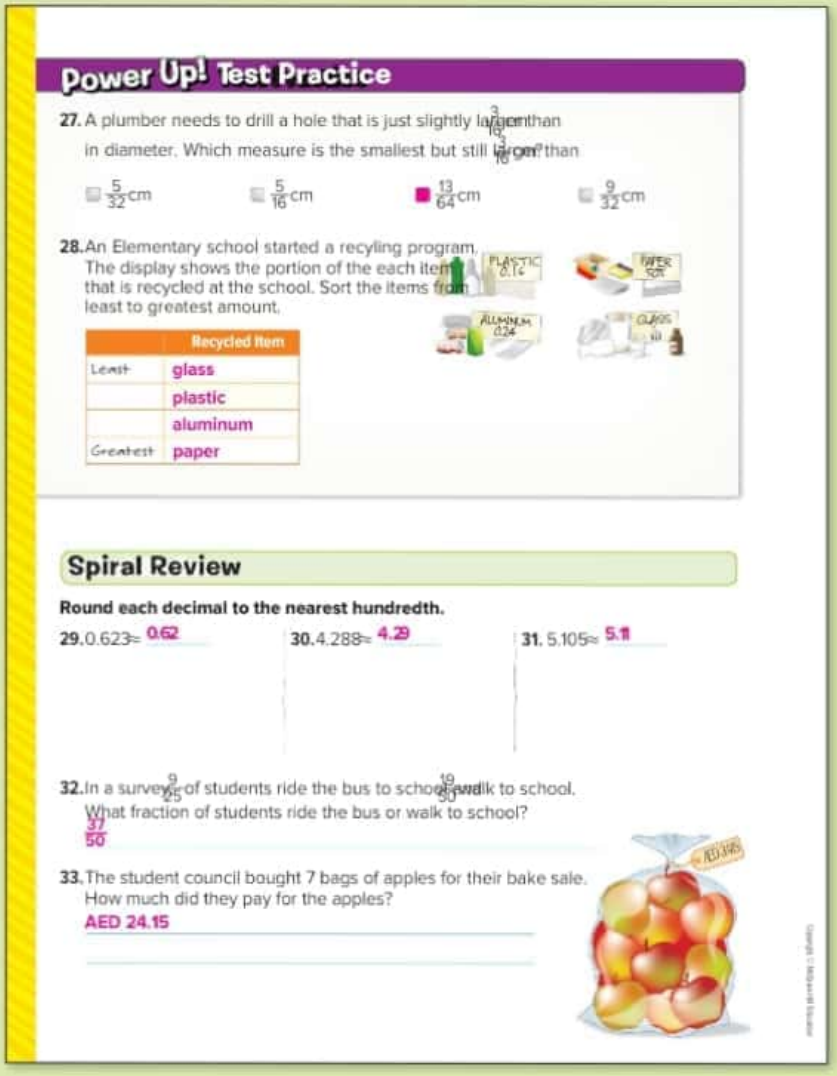
Exercises 27 and 28 prepare students for more rigorous thinking needed for the assessment.

27.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practices	MP2, MP6
Scoring Rubric	
1 point	Students correctly answer the question.

28.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK2
Mathematical Practices	MP1, MP2, MP6
Scoring Rubric	
2 points	Students correctly order all 4 items.
1 point	Students correctly order 3 of the 4 items.



Power Up! Test Practice

27. A plumber needs to drill a hole that is just slightly larger than $\frac{3}{16}$ cm in diameter. Which measure is the smallest but still larger than $\frac{3}{16}$ cm?

- ☐ $\frac{5}{32}$ cm
- ☐ $\frac{5}{16}$ cm
- ■ $\frac{13}{64}$ cm
- ☐ $\frac{9}{32}$ cm

28. An Elementary school started a recyling program. The display shows the portion of the each item that is recycled at the school. Sort the items from least to greatest amount.

PLASTIC 0.16 PAPER 0.20 ALUMINUM 0.24 GLASS 0.10

	Recycled Item
Least	glass
	plastic
	aluminum
Greatest	paper

Spiral Review

Round each decimal to the nearest hundredth.

29. 0.623 ≈ 0.62

30. 4.288 ≈ 4.29

31. 5.105 ≈ 5.11

32. In a survey, $\frac{9}{25}$ of students ride the bus to school and $\frac{19}{50}$ walk to school. What fraction of students ride the bus or walk to school?

$\frac{37}{50}$

33. The student council bought 7 bags of apples for their bake sale. How much did they pay for the apples?

AED 24.15

Lesson 6

Estimate with Percents

Real-World Link

Movies Houriyya surveyed 298 students and found that 52% like scary movies. Estimate the number of students that like scary movies.

0% | 25 % | 50 % | 75 % | 100%

0 | 75 | 150 | 225 | 300

1. Write the common percents from 0% to 100% at the top of the bar diagram.
2. What common percent is 52% close to? 50%
   Shade the bar diagram above to show your answer.
3. Round 298 to the nearest hundred. 300
   Write your answer in the box below 100%.
4. Use the bar diagram to estimate 52% of 298. Explain.
   Since 52% is close to 50% and 298 is close to 300, I can use the numbers in the bar diagram. Since 150 is 50% of 300, I can estimate that 150 is about 52% of 298.
5. Use the bar diagram below to estimate 73% of 400. 300

0% | 25 % | 50 % | 75 % | 100%

0 | 100 | 200 | 300 | 400

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

MP Mathematical Practices
1, 3, 4, 5

Which MP Mathematical Practices do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Estimate the percent of a number.

Coherence connecting within and across grades

Previous	Now	Next
Students compared and ordered fractions, decimals, and percents.	Students estimate the percent of a number.	Students will find the percent of a number.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 141.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Roundrobin** In groups of 3 or 4, Student 1 reads Exercise 1 aloud and leads the discussion t complete that exercise. Have Student 2 read aloud Exerci and lead the discussion to complete that exercise. Contin until all the exercises have been completed. Then have o group share their responses with the class. MP 1, 6

Alternate Strategies

AL Have students explain why finding 25% of a number is the same as dividing the number by 4. MP 4

BL Have students explain why finding 75% of a number is same as multiplying the number by 3, then dividing the re by 4. MP 1, 3

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. **Estimate the percent of a number.**

AL • *47% is close to what common percent?* 50%

• *To what value can we round 692?* Sample answer: 700

OL • *Into how many equal sections should we divide the bar diagram? Why?* 2; 50% is half which means two equal parts

• *What percent labels should be across the top of the bar diagram?* 0%, 50%, 100%

• *What values should be across the bottom of the bar diagram?* 0, 350, 700

BL • *Is there another way to generate a different estimate? Explain.* Sample answer: yes; Round 692 to 690. 50% of 690 is 345.

Need Another Example?

Estimate 49% of 300. Sample answer: $\frac{1}{2}$ of 300 is 150.

2. **Estimate the percent of a number.**

AL • *To what value can we round 27?* Sample answer: 25

OL • *Into how many equal sections should we divide the bar diagram? Why?* 5; 60% is a multiple of 20% and there are five 20%-sections in one whole, 100%

• *What percent labels should be across the top of the bar diagram?* 0%, 20%, 40%, 60%, 80%, 100%

• *What values should be across the bottom of the bar diagram?* 0, 5, 10, 15, 20, 25

BL • *Is there another way to generate a different estimate? Explain.* Sample answer: yes; Round 27 to 30. 60% of 30 is 18.

Need Another Example?

Estimate 80% of 1,655. Sample answer: $\frac{1}{5}$ of 1,500 = 300; $4 \times 300 = 1{,}200$

Work Zone

a. Sample answer: $\frac{1}{2}$ of 80 is 40.

b. Sample answer: $\frac{1}{5}$ of 40 is 8.

c. Sample answer: $\frac{3}{4}$ of 40 is 30.

Estimate the Percent of a Number

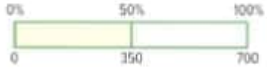
Estimating with percents will provide a reasonable solution to many real-world problems. Choose compatible numbers when estimating the percent of a number.

Examples

1. **Estimate 47% of 692.**

47% is close to 50% or $\frac{1}{2}$. Round 692 to 700.

$\frac{1}{2}$ of 700 is 350. $\frac{1}{2}$ or *half* means to divide by 2.



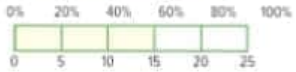
So, 47% of 692 is about 350.

2. **Estimate 60% of 27.**

60% is $\frac{3}{5}$.

Round 27 to 25 since it is divisible by 5.

$\frac{1}{5}$ of 25 is 5. $\frac{1}{5}$ or *one fifth*, means divide by 5.



So, $\frac{3}{5}$ of 25 is 3×5 or 15.

So, 60% of 27 is about 15.

Got it? **Do these problems to find out.**

Estimate each percent.

a. 48% of 76 b. 18% of 42 c. 73% of 41

Example

3. STEM **Polar bears can eat as much as 10% of their body weight in less than one hour. If an adult male polar bear weighs 715 pounds, about how much food can he eat in one hour?**

To determine how much food a polar bear can eat in one hour, you need to estimate 10% of 715.

Method 1 **Find equivalent ratios.**

$10\% = \frac{1}{10}$ and $715 \approx 700$

$\frac{1}{10} = \frac{\blacksquare}{700}$ Write the equivalent ratios.

$\frac{1}{10} = \frac{\blacksquare}{700}$ Since $10 \times 70 = 700$, multiply 1 by 70.

The unknown value is 70.

Method 2 **Use mental math.**

$10\% = \frac{1}{10}$ and $715 \approx 700$

$\frac{1}{10}$ of 700 is 70.

So, a polar bear can eat about 70 pounds of food in one hour.

Got it? **Do these problems to find out.**

d. Kawathar decided to donate 30% of her savings. If she has AED 238 in her savings account, about how much will she donate?

about AED 80

Estimate Using the Rate per 100

You can also estimate with percents using a rate per 100.

Examples

4. **Estimate 17% of 198.**

$17\% = 17$ out of 100 Write the percent as a rate per 100.

$198 \approx 200$ Round to the nearest hundred.

Since 200 is 100, add 17 to estimate 17% of 198.

34 is about 17% of 198.

Stop and Reflect

When would you use mental math to estimate the percent of a number? Explain below.

Sample answer: You might use mental math to find the amount discounted at a sale.

Examples

3. **Estimate part of a whole to solve a real-world example.**

AL
- *What is the problem asking you to find?* how many pounds of food a polar bear can eat in one hour
- *What information are you given?* the weight of the polar bear

OL
- *To what number can we round 715?* Sample answer: 700
- *What is 10% of 700?* 70

BL
- *Without using a bar diagram, is there another method you could use to find 10% of 700?* Sample answer: To find 10% of a number, divide by 10 or move the decimal point one place to the left. So, 10% of 700 is 70.

Need Another Example?

A CD that originally cost $11.90 is on sale for 25% off. About how much will you save by buying the CD on sale? about $3

4. **Estimate the percent of a number using a rate per 100.**

AL
- *To what value could we round 198?* Sample answer: 200
- *How many 100s are in 200?* 2
- *What is 17% of 100?* 17

OL
- *How can you write 17% as a rate per 100?* 17 out of 100
- *Write an addition expression you can use to estimate 17% of 198.* 17 + 17

BL
- *Is there another method you could use to solve this problem? Explain.* Sample answer: Round 17% to 20%. Find 10% of 200, which is 20. Then add to find 20%: 20 + 20 = 40. So, 17% of 198 is about 40.
- *Write a real-world problem that could represent this example.* Sample answer: A store is selling an MP3 player that sells for $198 at 17% off. By about how much is the price reduced for the sale? $34

Need Another Example?

Estimate 27% of 512. Sample answer: 27 + 27 + 27 + 27 = 135

Example

5. **Estimate the percent of a number using a rate per 100.**

AL • *To what value could we round 408?* Sample answer: 400

• *How many 100s are in 400?*

• *What is 9% of 100?*

OL • *How can you write 9% as a rate per 100?* 9 out of 100

• *Write a multiplication expression you can use to estimate 9% of 408?* 9 × 4

BL • *Is there another method you could use to solve this problem? Explain.* Sample answer: Round 9% to 10%. Find 10% of 400, which is 40.

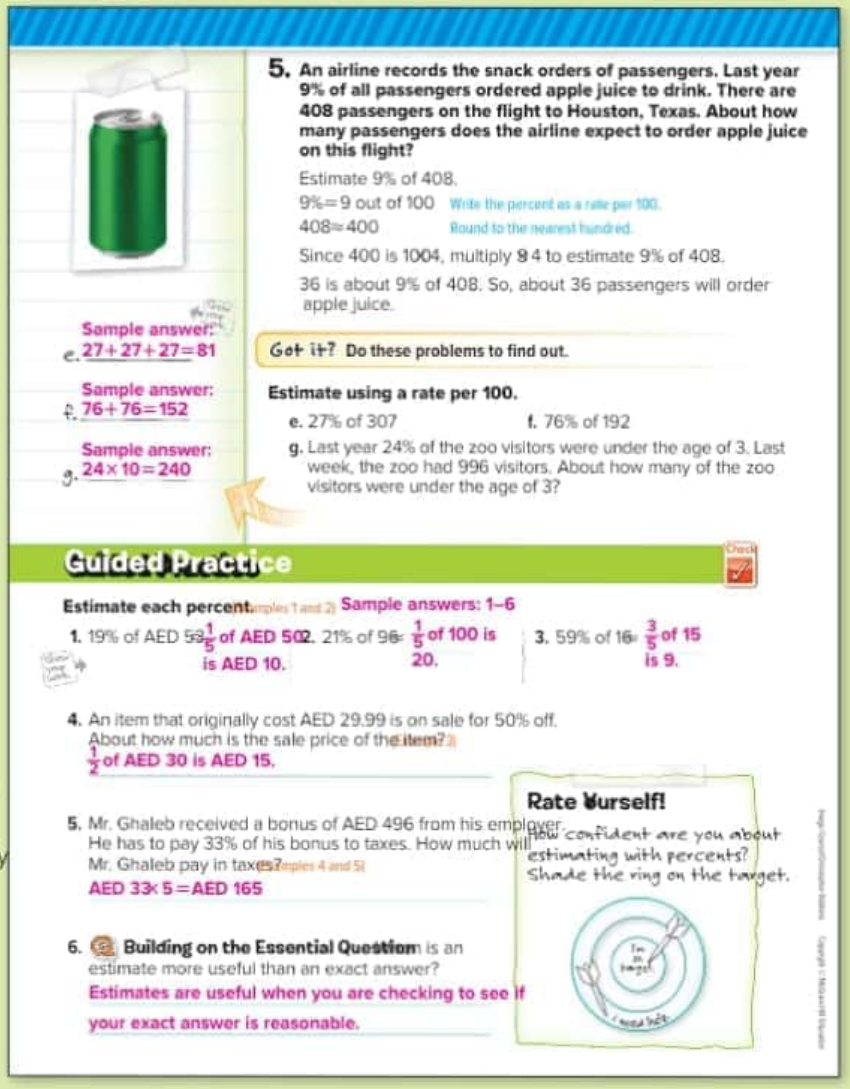
Need Another Example?
Marcie surveyed the students in her grade and learned that 64% of them have a pet. If there are 279 students in sixth grade, about how many have a pet? Sample answer: 64% ≈ 63 = 192 students

Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activity below.

AL LA **Find the Fib** Have students work in pairs to write three different estimates for one chosen exercise. Two of the estimates should be reasonable and the third should be a "fibbed" estimate, an unreasonable estimate. Have students trade papers with another pair of students to correctly identify the reasonable estimates and the fibbed estimate.



5. **An airline records the snack orders of passengers. Last year 9% of all passengers ordered apple juice to drink. There are 408 passengers on the flight to Houston, Texas. About how many passengers does the airline expect to order apple juice on this flight?**

Estimate 9% of 408.
9% ≈ 9 out of 100 Write the percent as a rate per 100.
408 ≈ 400 Round to the nearest hundred.
Since 400 is 100s, multiply 9 × 4 to estimate 9% of 408.
36 is about 9% of 408. So, about 36 passengers will order apple juice.

Got it? Do these problems to find out.

Estimate using a rate per 100.

e. 27% of 307 f. 76% of 192

g. Last year 24% of the zoo visitors were under the age of 3. Last week, the zoo had 996 visitors. About how many of the zoo visitors were under the age of 3?

e. Sample answer: 27 + 27 + 27 = 81

f. Sample answer: 76 + 76 = 152

g. Sample answer: 24 × 10 = 240

Guided Practice

Estimate each percent. Examples 1 and 2 Sample answers: 1–6

1. 19% of AED 53 $\frac{1}{5}$ of AED 50 is AED 10.
2. 21% of 96 $\frac{1}{5}$ of 100 is 20.
3. 59% of 16 $\frac{3}{5}$ of 15 is 9.

4. An item that originally cost AED 29.99 is on sale for 50% off. About how much is the sale price of the item? Example 3
$\frac{1}{2}$ of AED 30 is AED 15.

5. Mr. Ghaleb received a bonus of AED 496 from his employer. He has to pay 33% of his bonus to taxes. How much will Mr. Ghaleb pay in taxes? Examples 4 and 5
AED 33 × 5 = AED 165

6. **Building on the Essential Question** When is an estimate more useful than an exact answer?
Estimates are useful when you are checking to see if your exact answer is reasonable.

Rate Yourself!
How confident are you about estimating with percents? Shade the ring on the target.

Name _____ My Homework _____

Independent Practice

Estimate each percent. Examples 1 and 2 **Sample answers: 1–7**

1. 47% of AED 118 — $\frac{1}{2}$ of AED 120 is AED 60.
2. 19% of 72 — $\frac{1}{5}$ of 70 is 14.
3. 42% of 16 — $\frac{2}{5}$ of 15 is 6.
4. 67% of 296 — $\frac{2}{3}$ of 300 is 200.

Estimate using a rate per 100. Example 4

5. 24% of 289 — 24 + 24 + 24 = 72
6. 67% of 208 — 67 + 67 = 134

7. STEM Penguins spend almost 75% of their lives in the sea. An Emperor Penguin in the wild has a life span of about 18 years. About how many years does this penguin spend in the sea? Example 3
$\frac{3}{4}$ of 20 yr is 15 yr.

8. In Ismail's baseball card collection, 58% of the cards are players from the National League. He has 702 baseball cards. About how many baseball cards are players from the National League? Use a rate per 100 to estimate. Example 5
about 406; 587 = 406

9. **Model with Mathematics** Refer to the graphic novel frame below for Exercises a–b.

a. Suppose Rawan is shooting baskets and makes 40% of the 15 shots. Does he win a prize? Explain your reasoning.
no; 40% is $\frac{2}{5}$, and $\frac{2}{5}$ of 15 is 6. He needs 7 baskets to win a prize.

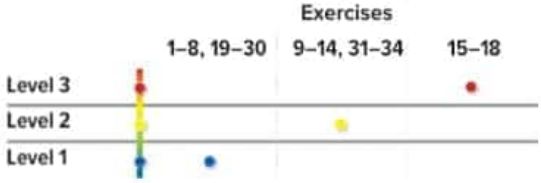
b. About what percent of the baskets need to be made in order to win a prize? about 50%

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

3 Practice and Apply

Independent Practice and Extra Practice
The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity
The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments
You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–9, 11, 13, 15, 17, 18, 33, 34
OL	On Level	1–9 odd, 10–15, 17, 18, 33, 34
BL	Beyond Level	18, 33, 34

Watch Out!
Common Error Watch for students who use incorrect fractio for percents, such as $\frac{1}{2}$ for 20% or $\frac{1}{4}$ for 40%. Suggest that students create and use a chart with common fraction-per equivalents.

MATHEMATICAL PRACTICES	
Emphasis On	**Exercise(s)**
1 Make sense of problems and persevere in solving them.	16
3 Construct viable arguments and critique the reasoning of others.	15, 17
4 Model with mathematics.	9, 18
5 Use appropriate tools strategically.	12–14, 31, 32

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET
Out the Door

Have students find a reasonable estimate for 78% of 39.
Sample answer: $\frac{1}{5} \times 40 = 32$

10. About 42% of Alaska's population lives in the city of Anchorage. If Alaska has a total population of 648,818, about how many people live in Anchorage?
Sample answer: about 260,000; $\frac{2}{5}$ of 650,000 is 260,000.

11. During the basketball season, Tyrone made 37 baskets out of 71 attempts. About what percent of his shots did he miss?
Sample answer: 71 − 37 = 34 missed shots and $\frac{34}{71}$ is about $\frac{35}{70}$ or $\frac{1}{2}$. Since $\frac{1}{2} = 50\%$, he missed about 50% of his shots.

Use Math Tools Estimate the percent that is shaded in each figure.

12. about 25%

13. about 75%

14. about 40%

H.O.T. Problems Higher Order Thinking

15. Reason Inductively Noor wants to buy a shirt regularly priced at AED 32. It is on sale for 40% off. Noor estimates that she will save $\frac{2}{5}$ of AED 30 or AED 12. Will the actual amount be more or less than AED 12? Explain.
more; Noor rounded AED 32 down to AED 30, so the actual amount she will save will be more than AED 12.

16. Persevere with Problems Consider 10% of 20, 20% of 20, $\frac{1}{5}$ of 20 and $\frac{1}{10}$ of 20 from least to greatest.
$\frac{1}{10}$ of 20, 10% of 20, 20% of 20, $\frac{1}{5}$ of 20

17. Construct an Argument A classmate is trying to estimate 42% of AED 122. Explain how your classmate should solve the problem.
Sample answer: First, round 42% to 40%, and AED 122 to AED 125. Next, rewrite 40% as $\frac{2}{5}$. Then find $\frac{1}{5}$ of AED 125. Finally, multiply this result by 2 to find $\frac{2}{5}$ of AED 125.

18. Model with Mathematics Muneera's homeroom has raised 63% of its goal for the school fundraiser. Malik's homeroom has raised 48%. Create a situation in which Malik's homeroom raised more money than Muneera's homeroom.
Sample answer: Muneera's homeroom has raised 63% of its goal to raise AED 500 for the school fundraiser. Malik's homeroom has raised 48% of its AED 1,000 goal. How much has each homeroom raised?
Muneera's homeroom: AED 315; Malik's homeroom: AED 480

Name _____ My Homework _____

Extra Practice

Estimate each percent. Sample answers: 19–30

19. 53% of 59
$\frac{1}{2}$ of 60 is 30.
53% is close to 50% or $\frac{1}{2}$. Round 59 to 60.

20. 35% of 147
$\frac{1}{3}$ of 150 is 50.

21. 26% of 125
$\frac{1}{4}$ of 120 is 30.

22. 79% of 82
$\frac{4}{5}$ of 80 is 64.

Estimate using a rate per 100.

23. 19% of 288
19 + 19 + 19 = 57

24. 74% of 315
74 + 74 + 74 = 222

25. 61% of 407
61 + 61 + 61 + 61 = 244

26. 89% of 195
89 + 89 = 178

27. Waleed spent 8 hours and 15 minutes at an amusement park yesterday. He spent 75% of the time at the park on rides. About how much time did he spend on rides?
$\frac{3}{4}$ of 8 h is 6 h.

28. A group of friends went on a hiking trip. They planned to hike a total of 38 km. They want to complete 25% of the hike by the end of the first day. About how far should they hike the first day?
about 10 km

29. Aseel has just finished her Grade 6 scrapbook. In her scrapbook, 47% of the pages include her twin sister, Wassan. The scrapbook has 896 photos. About how many photos include Wassan? Use a rate per 100 to estimate.
about 423; 479 = 423

30. The community garden has 596 vegetables. In the garden, 64% of the vegetables are green vegetables. About how many vegetables in the garden are green? Use a rate per 100 to estimate.
about 384; 646 = 384

Use Math Tools Estimate the percent that is shaded in each figure.

31.

about 75%

32.

about 60%

Power Up! Test Practice

Exercises 33 and 34 prepare students for more rigorous thinking needed for the assessment.

33.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP1
Scoring Rubric	
1 point	Students correctly answer the question.

34.

This test item requires students to support their reasoning or evaluate the reasoning of others by justifying their response and constructing arguments.	
Depth of Knowledge	DOK3
Mathematical Practices	MP2, MP3
Scoring Rubric	
2 points	Students determine the items that can be purchased AND explain the process.
1 point	Students select the appropriate items, but fail to explain.

Power Up! Test Practice

33. In a survey of teens, 21% said their friends like to read and talk about books. About how many teens out of 1,095 would say their friends read and talk about books?

200 teens

34. Saleh wants to buy the items shown in the table. He has a coupon that will take 20% off his total purchase and he has AED 50 to spend. What items can he purchase to spend the most of the AED 50 after applying the coupon? Explain.

Sample answer: He can buy the jeans, khaki pants, and the T-shirts. The total cost before the coupon is AED 25 + AED 20 + AED 15 or AED 60. After the coupon is applied, the total cost is AED 60 − AED 12 or AED 48.

Item	Cost (AED)
jeans	25
khaki pants	20
package of socks	10
polo shirt	15
3 T-shirts	15

Spiral Review

Write each fraction as a decimal.

35. $\frac{22}{100} = 0.22$

36. $\frac{7}{100} = 0.07$

37. $\frac{67}{100} = 0.67$

38. $\frac{15}{100} = 0.15$

39. $\frac{12}{100} = 0.12$

40. $\frac{6}{100} = 0.06$

41. At a clothing store, T-shirts are on sale for AED 9.97 each. What is the cost of 3 T-shirts?

AED 29.91

42. The Al Jassmi family planted a garden with the dimensions shown. What is the area of the garden?

22.5 m²

Inquiry Lab
Percent of a Number

Inquiry **HOW can you model the percent of a number?**

MP Mathematical Practices 1, 3, 4

There were 180 people in a movie theater. Twenty percent of them received the student discount and 10% received the senior citizen discount. The rest did not receive a discount. How many people did not receive a discount?

What do you know? Of 180 people, 20% received student discounts and 10% received senior citizen discounts.

What do you need to find? the number of people who did not receive a discount

Hands-On Activity

Model the situation using two bar diagrams.

Step 1 Use a bar diagram to represent 100%. Then use another bar diagram of equal length to represent 180 people.

student discount | senior discount

percent	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
people	18	18	18	18	18	18	18	18	18	18

Step 2 Divide each bar into 10 equal parts. Think: 180 ÷ 10 = 18

So, each part of 180 represents 18 people.

Step 3 Determine how many people did not receive a discount. Shade 2 sections of each bar diagram to represent the student discount. Shade 1 section of each bar diagram to represent the senior discount.

There are 7 unshaded sections in each bar diagram.

7 × 18 = 126

So, 126 people at the movie did not receive a discount.

Focus narrowing the scope

Objective Model the percent of a number.

Coherence connecting within and across grades

Now Students use models to find the percent of a number.

Next Students will find the percent of a number.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 146.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lab

The activity is intended to be used as a whole-group activ

Hands-On Activity

AL BL LA **Circle the Sage** Poll students to determine who has a solid understanding of using models, such as b diagrams, to model percents. Have those students (the sa spread out around the room. Create teams with the remai students. Send team members to work with a sage, makin sure no two team members work with the same sage, if possible. Have the sages lead the activity, making sure everyone in the group understands and can explain the concepts to others. When the activity is complete, send students back to their original teams to discuss solutions and differences in how the activity was taught by the sage

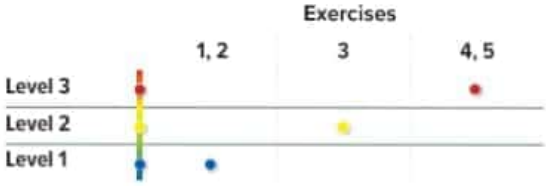
MP 1, 3, 5

2 Collaborate

The **Investigate** and **Analyze and Reflect** sections are intended to be used as small-group investigations. The **Create** section is intended to be used as independent exercises.

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level 1 indicating the lowest level of complexity.



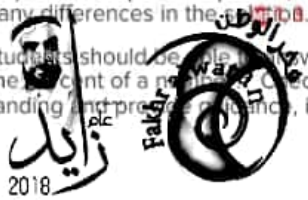
Analyze and Reflect

AL LA **Think-Pair-Share** Give students one minute to think through their response to Exercise 3. Have them verbally share their response with their partner, making sure to speak clearly, and then listen carefully while their partner speaks. Have students correct any errors. Then call on students to share their response with the whole class.

Create

BL LA **Trade-a-Problem** Have students omit their answer to the problem they wrote in Exercise 4. Then have them trade their problems with a partner. Each partner solves the other student's problem. Upon completion, have them discuss and resolve any differences in the solutions.

Inquiry Students should be able to answer "HOW can you model the percent of a number?" Check for student understanding and provide assistance, if needed.



Investigate

MP **Model with Mathematics** Work with a partner. Find the part of each whole using two bar diagrams.

1. 50% of 80 children? 40 children

50%	50%	100%
40	40	children

2. 25% of AED 32 AED 8

25%	25%	25%	25%	100%
8	8	8	8	AED 32

Analyze and Reflect

3. MP **Reason Inductively** Explain how to use two bar diagrams to find 45% of AED 60.
Sample answer: Divide each bar into 20 sections. Each section represents 5%. Nine sections will be shaded since 9 × 5 = 45. Since 60 ÷ 20 = 3, each section also represents AED 3. So, 45% of AED 60 is AED 27 because AED 27.

Create

4. MP **Model with Mathematics** Create and solve a real-world problem about finding the percent of a number.
Sample answer: A survey showed that 70% of middle school students buy their lunch. There are 280 students at Al Qalaa Middle School. How many students buy their lunch? 196 students

5. Inquiry HOW can you model the percent of a number?
Sample answer: You can use two bar diagrams of equal length. Divide each bar diagram into equal parts to find your answer.

Lesson 7

Percent of a Number

Real-World Link

Snacks In a survey, 200 students chose their favorite snacks. Use the table to find the number of students who chose each snack.

Snack	Percent	Fraction	Equivalent Fraction	Number of Responses
Fruit	23%	$\frac{23}{100}$	$\frac{46}{200}$	46 out of 200
Cheese	15%	$\frac{15}{100}$	$\frac{30}{200}$	30 out of 200
Veggies	17%	$\frac{17}{100}$	$\frac{34}{200}$	34 out of 200
Cookies	15%	$\frac{15}{100}$	$\frac{30}{200}$	30 out of 200
Chips	18%	$\frac{18}{100}$	$\frac{36}{200}$	36 out of 200
No Snack	12%	$\frac{12}{100}$	$\frac{24}{200}$	24 out of 200

Check Add the number of responses in the last column.

46 + 30 + 34 + 30 + 36 + 24 = 200 ✓

1. How does finding the percent as a rate per 100 help you find the number of responses out of 200?

Sample answer: You can use the fraction with a denominator of 100 to find an equivalent fraction with a denominator of 200, the total number of responses.

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Mathematical Practices

1, 3, 4, 5

Which **Mathematical Practices** do you use? Shade the circle(s) that applies.

- ① Persevere with Problems
- ② Reason Abstractly
- ③ Construct an Argument
- ④ Model with Mathematics
- ⑤ Use Math Tools
- ⑥ Attend to Precision
- ⑦ Make Use of Structure
- ⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Find the percent of a number.

Coherence connecting within and across grades

Previous	Now	Next
Students used models to find the percent of a number.	Students find the percent of a number.	Students will solve percent problems.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 151.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA Pairs Discussion Have students work in pairs to complete the table. Have them discuss how th would alter the table if there were a total of 300 students. MP 1, 3, 5

Alternate Strategies

AL LA Remind the students that they find equivalent rat by multiplying the numerator and denominator by the sam number. Ask them why they used the factor 2 in all of the problems. MP 1

BL Ask the students how they would alter the table if the were 250 students. Have them complete the table using of 250 student MP 1, 5

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Example

1. Find the percent of a number.

AL • *What percent of students bring cheese as a snack?* 15%

• *How many students are at the middle school?* 300

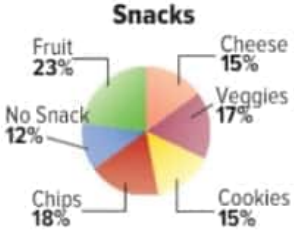
OL • *What is 15% written as a fraction in simplest form?* $\frac{3}{20}$

• *To find $\frac{3}{20}$ of 300, what operation must you perform?* multiplication

• *Explain the steps in finding $\frac{3}{20}$ × 300.* Sample answer: Write 300 as an improper fraction. Then divide 20 and 300 by their GCF, 20. Then find 15, which is 45.

BL • *Compare and contrast Method 1 and Method 2. Which do you prefer?* Method 1 uses the percent written as a fraction. Method 2 uses the percent written as a decimal; See students' preferences.

Need Another Example?
Refer to the circle graph below. Suppose there are 300 students at York Middle School. Find the number of students that have veggies as a snack. 51 students



Work Zone

STOP and Reflect
If 50 students were surveyed, how many students chose no snack?

6 students

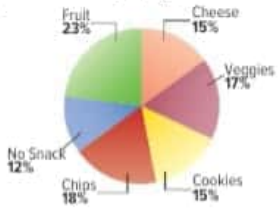
54 students

Find the Percent of a Number

You can use fractions and decimals to find the percent of a number. To find the percent of a number, write the percent as a fraction with a denominator of 100. Then multiply the fraction by the number.

Example

1. **Refer to the circle graph. Suppose there are 300 students at Lakes Middle School. Find the number of students that have cheese as a snack.**



Method 1 **Write the percent as a fraction.**

$15\% = \frac{15}{100}$ or $\frac{3}{20}$ Write the percent as a rate per 100.

$\frac{3}{20}$ of $300 = \frac{3}{20} \times 300$ Multiply.

$= 45$

Method 2 **Write the percent as a decimal.**

$15\% = 0.15$

0.15 of $300 = 0.15 \times 300$

$= 45$

So, 45 students have cheese as a snack.

Check Use a bar diagram.

$30 + \frac{1}{2} \times 30 = 30 + 15$ or 45 ✓

Get It? **Do these problems to find out.**

a. Find the number of students at Lakes Middle School that have chips as a snack.

Percents Greater Than 100% and Less T

You may choose whether to write a percent as a fraction or as a decimal based on the problem.

Examples

2. **Find 145% of 320.**

$145\% = \frac{145}{100}$ or $\frac{29}{20}$ — Write 145% as a rate per 100. Then simplify.

145% of 320 $= \frac{29}{20} \times 320$ — Write the multiplication problem.

$= \frac{29}{\cancel{20}_{1}} \times \frac{\overset{16}{\cancel{320}}}{1}$ — Divide the numerator and denominator by 20.

$= 29 \times 16$ — Simplify.

$= 464$ — Multiply.

So, 145% of 320 is 464.

3. **Find 220% of 65.**

$220\% = \frac{220}{100}$ or $\frac{11}{5}$ — Write 220% as a fraction in simplest form.

220% of 65 $= \frac{11}{5} \times 65$ — Write the multiplication problem.

$= \frac{\frac{11}{5} \times \frac{\overset{13}{\cancel{65}}}{1}}{1}$ — Divide by the GCF.

$= 11 \times 13$ — Simplify.

$= 143$ — Multiply.

So, 220% of 65 is 143.

4. **Find 0.25% of 58.**

$0.25\% = 0.0025$ — Write 0.25% as a decimal.

0.25% of 58 $= 0.0025 \times 58$ — Write the multiplication problem.

$= 0.145$ — Multiply.

So, 0.25% of 58 is 0.145.

Got it? **Do these problems to find out.**

Find the percent of each number.

b. 128% of 550 **c.** 0.3% of 200 **d.** 0.85% of 600

b. 704

c. 0.6

d. 5.1

Examples

2. **Find the percent of a number.**

AL • *Is $\frac{145}{100}$ in simplest form?* no

OL • *How do you simplify $\frac{145}{100}$?* Divide 145 and 100 by their GCF, 5.

• *What is 145% written as a fraction in simplest form?* $\frac{29}{20}$

• *How would you find $\frac{29}{20}$ of 320?* Multiply $\frac{29}{20}$ by 320.

BL • *How do you know that the answer is reasonable?*
145% is almost 150%. 100% of 320 is 320 and 50% of 32 is 160; 320 + 160 = 480 and 464 is close to 480.

Need Another Example?
Find 125% of 140. 175

3. **Find the percent of a number.**

AL • *What is 220% written as an improper fraction in simplest form?* $\frac{11}{5}$

OL • *Write an equation to find 220% of 65.* $\frac{11}{5} \times 65 = 143$ or $\frac{11}{5} \times \frac{65}{1} = 143$

BL • *How can you check the reasonableness of the answer?*
Sample answer: 220% will be more than twice the value $65 \times 2 = 130$, so an answer of 143 is reasonable.

Need Another Example?
Find 275% of 60. 165

4. **Find the percent of a number.**

AL • *To write 0.25% as a decimal, do you move the deci point two places to the right or two places to the le* two places to the left

OL • *How would you find 0.0025 of 58?* Multiply 0.0025 by 58.

BL • *How can you check the reasonableness of the answer?*
Sample answer: 0.25% is less than 1% of the value. 1% o is 0.58. So, an answer of 0.145 is reasonable.

Need Another Example?
Find 0.45% of 50. 0.2475

Example

5. Solve a real-world problem involving the percent of a number.

AL • *What is the problem asking you to find?* how many athletes competed in soccer

• *How many total players were on the Special Olympics team?* 70 *What percent of the team played soccer?* 20%

OL • *What decimal is equivalent to 20%?* 0.20 or 0.2

BL • *Explain another method to solve the problem.* Sample answer: Change 20% to the fraction $\frac{1}{5}$ and multiply by 70.

Need Another Example?
A sandwich shop sold 75 sandwiches at lunchtime. Twelve percent of the sandwiches were grilled cheese. How many grilled-cheese sandwiches did the shop sell?

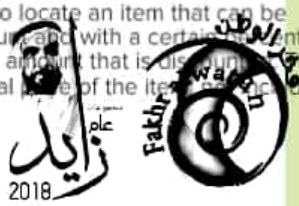
Guided Practice

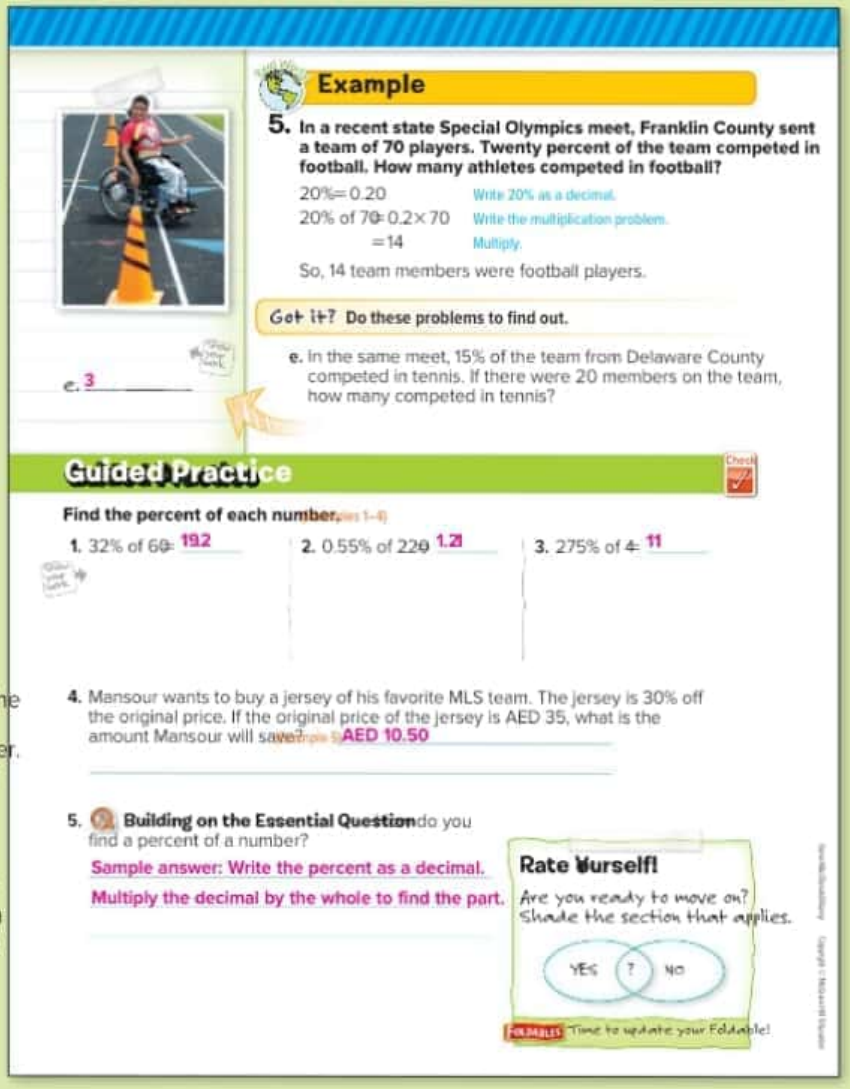
Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the differentiated activities below.

AL LA **Think-Pair-Share** Have pairs of students complete each exercise, with one student using a bar diagram to find the percent of each number, and the other student writing each percent as a fraction or decimal and multiplying by the number. Ask the pair to discuss the advantages and disadvantages of each method. MP 1, 3, 5

BL LA **Pairs Consult** Have pairs of students use the Internet, or another source, to locate an item that can be purchased for a certain amount and with a certain percent of discount. Have pairs find the amount that is discounted. Then have them determine the final price of the item, including tax. MP 1, 5





Example

5. In a recent state Special Olympics meet, Franklin County sent a team of 70 players. Twenty percent of the team competed in football. How many athletes competed in football?

20% = 0.20 Write 20% as a decimal.
20% of 70 = 0.2 × 70 Write the multiplication problem.
= 14 Multiply.

So, 14 team members were football players.

Got it? Do these problems to find out.

e. In the same meet, 15% of the team from Delaware County competed in tennis. If there were 20 members on the team, how many competed in tennis? e. 3

Guided Practice

Find the percent of each number. Exs 1–4

1. 32% of 60 = 19.2
2. 0.55% of 220 = 1.21
3. 275% of 4 = 11
4. Mansour wants to buy a jersey of his favorite MLS team. The jersey is 30% off the original price. If the original price of the jersey is AED 35, what is the amount Mansour will save? Sample answer: AED 10.50
5. **Building on the Essential Question** How do you find a percent of a number?
   Sample answer: Write the percent as a decimal. Multiply the decimal by the whole to find the part.

Rate Yourself!
Are you ready to move on? Shade the section that applies.

FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

The cafeteria at a Jumeriah middle school surveyed 575 students about their favorite food. Find the number of students that responded for each of the following. (Example 1)

1. chicken: 8% — 46
2. salad: 20% — 115
3. burgers: 16% — 92
4. fruit: 24% — 138

Find the percent of each number. (Examples 2–4)

5. 0.9% of 1,000 — 9
6. 0.46% of 80 — 0.368
7. 350% of 96 — 336
8. 222% of 55 — 122.1

9. The original price of a pair of shoes is AED 42. The sale price is 20% off the original price. What is the amount off the original price? (Example 5) — AED 8.40

10. Najla had AED 20 to buy a present for her father. She decided to buy a DVD for AED 18. The sales tax is 7%. Does she have enough money? Explain your reasoning.
yes; Sample answer: The total price with sales tax is AED 19.26.

11. Twenty-four students in Jamal's class are wearing tennis shoes. There are thirty students in his class. Jamal says that 70% of his class is wearing tennis shoes. Is Jamal correct? Explain your reasoning.
no; 70% of 30 is 21, not 24. 80% of 30 is 24.

12. **Use Math Tools** Sultan keeps track of his weekly quiz grades as shown in the table.

Test	Number Correct	Score	Total
Math	68	80%	85
Science	63	90%	70

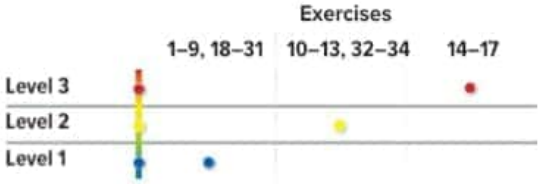
a. Complete the table.
b. In which class did Sultan have the higher score?
science
c. Suppose Sultan scored a 96% on an English test. There were 50 questions on the test. How many did Sultan answer correctly?
48 questions

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

3 Practice and Apply

Independent Practice and Extra Practice
The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity
The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments
You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–9, 11, 13–15, 33, 34
OL	On Level	1–9 odd, 10–15, 33, 34
BL	Beyond Level	10–17, 33, 34

Common Error Watch for students who change percents to incorrect decimals, especially when the percents involve decimals, have more than two digits, or fewer than two di Remind students to divide by 100 or move the decimal po two places to the left when changing percents to decimals

MATHEMATICAL PRACTICES	
Emphasis On	**Exercise(s)**
1 Make sense of problems and persevere in solving them.	16, 17
3 Construct viable arguments and critique the reasoning of others.	15
4 Model with mathematics.	14
5 Use appropriate tools strategically.	12, 13, 32

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment

Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Ask students to find 17% of 190.

13. **Use Math Tools** Use the graphic organizer to compare and contrast percents and fractions. Use the phrases *less than*, *equal to*, and *greater than* to complete each statement. Write an example in the space provided.
Sample answers given for examples.

Percent	Fraction
A whole is represented by a percent that is **equal to** 100%. Example: **100%**	A whole is represented by a fraction with a numerator that is **equal to** the denominator. Example: $\frac{3}{3}$
Part of a whole is represented by a percent that **less than** 100%. Example: **25%**	Part of a whole is represented by a fraction with a numerator that **less than** the denominator. Example: $\frac{1}{3}$
An amount that is greater than one is represented by a percent that is **greater than** 100%. Example: **125%**	An amount that is greater than one is represented by a fraction with a numerator that **greater than** the denominator. Example: $\frac{4}{3}$

H.O.T. Problems Higher Order Thinking

14. **Model with Mathematics** Write and solve a real-world problem in which the part of a whole results in a number greater than the whole itself.
Sample answer: The population of goldfish in a backyard pond grew by 150% over the summer. If there were originally 46 fish, what was the population at the end of the summer? 115 goldfish

15. **Justify Conclusions** Is 16% of 40 the same as 40% of 16? Explain your reasoning. **yes; 16% of 40 is 6.4 and 40% of 16 is 6.4.**

16. **Persevere with Problems** Find 15% of 15% of 15% of 500. How does this compare to finding 45% of 500? **3.375; It is less than 45% of 500, which is 225.**

17. **Persevere with Problems** A number is 25% of some number and 35% of a number. If $a > b$, $a < b$, or is it impossible to determine the relationship? Explain. **Sample answer: If a number is 25% of a and 35% of b, it is a greater part of b than it is of a. So, $a > b$.**

Name _____ My Homework _____

Extra Practice

Find the percent of each number.

18. 6% of 95
5.7

6% = 0.06
0.06 × 95 = 5.7

19. 15% of 110
16.5

20. 75% of 260
195

21. 28% of 575
161

22. 0.6% of 36
0.216

23. 108% of 148
159.84

24. 102% of 750
765

25. 0.03% of 1,500
0.45

26. Manal completes 65% of her first serves. If she attempted 80 first serves last match, how many did she complete?
52

27. Hamdan is mixing a cleaning solution that is 12% bleach. After mixing the solution, he has 150 ounces of cleaning solution. How many ounces of bleach did Hamdan use?
18 ounces of bleach

28. What is 38% of 250?
95

29. 76% of 524 is what number?
398.24

30. What is 26% of 360?
93.6

31. 55% of 387 is what number?
212.85

32. **Use Math Tools** Mr. Zayed tracks sales of ski equipment each week for a month. Complete the table to determine which week had the highest percent of ski equipment sales.
Week 2

Week Number	Ski Equipment Sales (AED)	Percent of Total Sales	Total Sales
1	200	50	400
2	175	70	250
3	195	65	300
4	110	40	275

Power Up! Test Practice

Exercises 33 and 34 prepare students for more rigorous thinking needed for the assessment.

33.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practices	MP4, MP7
Scoring Rubric	
1 point	Students correctly answer the question.

34.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK2
Mathematical Practices	MP2, MP6
Scoring Rubric	
1 point	Students determine the number of cars for each of the three types of vehicles.

Power Up! Test Practice

33. What expression can be used to find the total discount? Select all that apply.

- ■ 0.3×42
- ■ $\frac{3}{10} \times 42$
- □ 0.03×42
- ■ 3×4.2

34. There are 450 vehicles in a car lot. Select the correct value for the number of vehicles of each type that are in the lot.

Type of Vehicle	Percent of All Cars	Number Cars
hybrid	28	126
sport utility	20	90
sedan	38	171

90	171
95	180
126	200
135	

Spiral Review

Multiply.

35. $1.63 \times 20 =$ 32.6

36. $7.5 \times 12 =$ 90

37. $0.6 \times 15 =$ 9

38. Adnan has 4 trading cards. Husam has 8 trading cards. How many times more cards does Husam have than Adnan? 2 times

39. The art club had the members vote on three places to take a field trip. The results are in the table. If all of the members voted, what part of the club voted for the Carnegie Museum of Art?

Trip	Part of Club
Carnegie Museum of Art	0.32
Fallingwater	0.20
Westemoreland Museum of Australian Art	0.48

Ratios and Proportional Relationships

Lesson 8 Solve Percent Problems

Vocabulary Start-Up

A **proportion** is an equation that shows that two ratios are equivalent. In a **percent proportion** one ratio compares a part to the whole. The other ratio is the equivalent percent written as a fraction with a denominator of 100.

How do you compare part and whole?

fraction	ratio	percent
$\frac{2}{5}$ $\frac{\text{part}}{\text{whole}}$	Using the information in the first ratio, fill in the others. $\frac{2}{5}$	$\frac{2}{5}=\frac{40}{100}$
What do you call the part? numerator	2 to 5	40 % of 5=2
the whole? denominator	2 : 5	

Essential Question

WHEN is it better to use a fraction, a decimal, or a percent?

Vocabulary

proportion
percent proportion

Mathematical Practices

1, 2, 3, 4, 7

Real-World Link

Basketball Suha is on her school basketball team. She has completed 9 out of 12 free throw shots successfully. Write the ratio as a percent and as a fraction in simplest form.

75%, $\frac{3}{4}$

Which **Mathematical Practices** do you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Focus narrowing the scope

Objective Solve percent problems to find the whole.

Coherence connecting within and across grades

Previous	Now	Next
Students found the percent of a number.	Students solve percent problems to find the whole, given the part and the percent.	Students will use the percent proportion and percent equation to find the percent of a number.

Rigor pursuing concepts, fluency, and applications

See the Levels of Complexity chart on page 159.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ideas for Use

You may wish to launch the lesson using a whole group, s group, think-pair-share activity, or independent activity.

LA **Pairs Consult** Have students complete the graphic organizer individually. Then have them share their responses with a partner. Call on one pair of students to share their responses with the class.

Alternate Strategies

AL LA Remind students that percent is a ratio of a num to 100. Point out that the 100 always represents the whole is placed in the denominator of the fraction.

BL Have the students consider the meaning of a numbe like 220% using the ratio and part/whole descriptions.

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

2 Teach the Concept

Ask the scaffolded questions for each example to differentiate instruction.

Examples

1. Use a number line to find the whole.

AL • *What number is the part? What number is the percent?* 10; 25

• *Into how many parts should the number line be divided? Why?* 4; 25% is one fourth which indicates four equal parts

OL • *What should be the percent labels on the number line?* 0%, 25%, 50%, 75%, 100%

• *What percent should be placed at 10 on the number line? Why?* 25%, 10 is the part

BL • *Explain another method you could use to find the whole.* Sample answer: You could divide the part, 10, by the percent as a decimal, 0.25: 10 ÷ 0.25 = 40.

Need Another Example?
30 is 60% of what number? 50

2. Use a number line to find the whole.

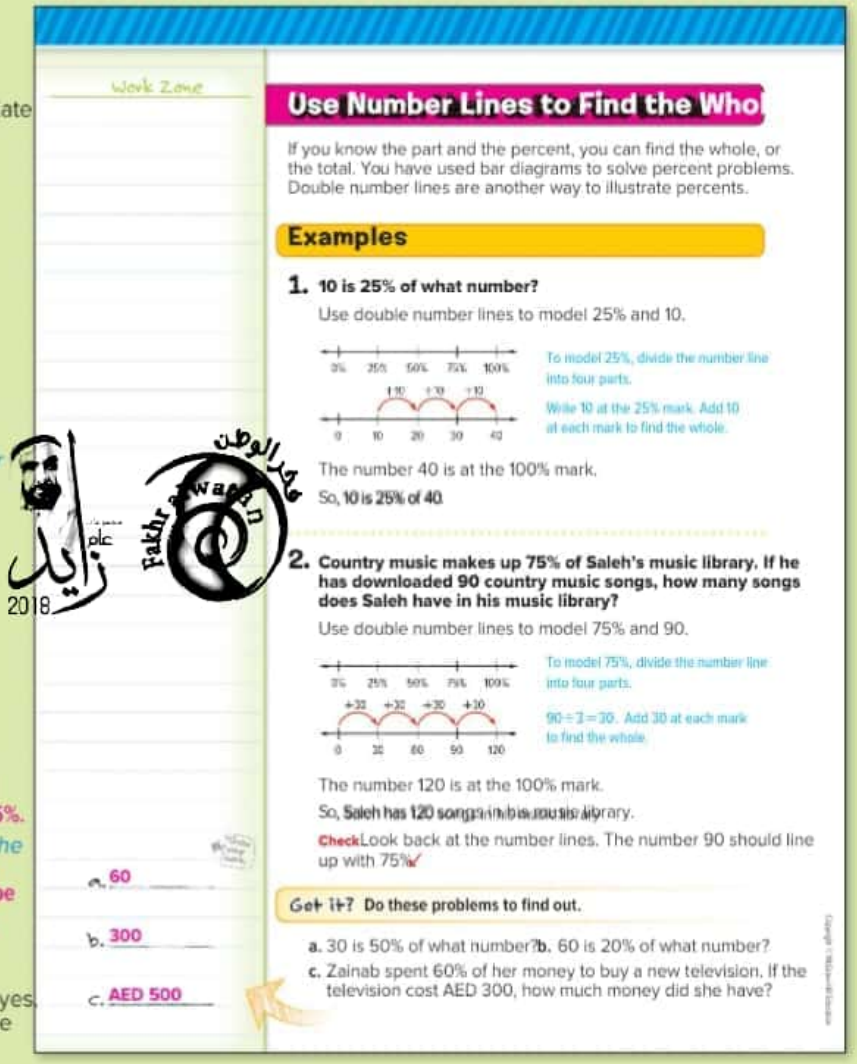
AL • *How many country songs does Landon have?* 90

• *What percent of his music library do these songs make up?* 75%

OL • *Into how many sections should the number line be divided? Explain.* We are looking for 75%, so the number line is divided into 4 sections, so that each represents 25%.

BL • *Explain how you can check the reasonableness of the answer.* Sample answer: We know that 75% of Landon's music library is 90 songs. All of his songs, or 100%, will be greater than 90. An answer of 120 seems reasonable to include the other 25% of his songs.

Need Another Example?
Forty percent of the students in Miguel's class have blue eyes. If there are 10 students with blue eyes, how many are in the class? 25 students



Work Zone

a. 60

b. 300

c. AED 500

Use Number Lines to Find the Who

If you know the part and the percent, you can find the whole, or the total. You have used bar diagrams to solve percent problems. Double number lines are another way to illustrate percents.

Examples

1. 10 is 25% of what number?

Use double number lines to model 25% and 10.

To model 25%, divide the number line into four parts.

Write 10 at the 25% mark. Add 10 at each mark to find the whole.

The number 40 is at the 100% mark.

So, 10 is 25% of 40.

2. Country music makes up 75% of Saleh's music library. If he has downloaded 90 country music songs, how many songs does Saleh have in his music library?

Use double number lines to model 75% and 90.

To model 75%, divide the number line into four parts.

90 ÷ 3 = 30. Add 30 at each mark to find the whole.

The number 120 is at the 100% mark.

So, Saleh has 120 songs in his music library.

Check Look back at the number lines. The number 90 should line up with 75%.

Get It? Do these problems to find out.

a. 30 is 50% of what number? b. 60 is 20% of what number?

c. Zainab spent 60% of her money to buy a new television. If the television cost AED 300, how much money did she have?

Use the Percent Proportion

The diagram uses a percent proportion to show that 75% of 32 is 24.

part → $\frac{24}{32} = \frac{75}{100}$ percent
whole →

Examples

3. **15 is 30% of what number?**

Words 15 is 30% of what number?

Proportion $\frac{\text{part}}{\text{whole}} \rightarrow \frac{15}{\blacksquare} = \frac{30}{100}$ percent

$\frac{15}{\blacksquare} = \frac{30}{100}$ Write the proportion.

$\frac{15}{50} = \frac{30}{100}$ (+2) Since 15 is one half of 30, divide 100 by 2.

So, 15 is 30% of 50.

4. **225 is 75% of what number?**

$\frac{225}{\blacksquare} = \frac{75}{100}$ Write the proportion.

$\frac{225}{300} = \frac{75}{100}$ Since 75 × 3 = 225, multiply 100 by 3.

So, 225 is 75% of 300.

Stop and Reflect

Write a percent proportion below to show that 50 is 25% of 200.

$\frac{50}{200} = \frac{25}{100}$

Got it? Do these problems to find out.

d. 75 is 15% of what number? 500

e. 9 is 36% of what number? 25

f. 7 is 70% of what number? 10

g. 7 is 35% of what number? 20

Examples

3. **Use the percent proportion.**

AL • *Are you asked to find the percent, the part, or the whole?* the whole
• *What is the part?* 15 *What is the percent?* 30%

OL • *How would you set up the percent proportion?* $\frac{15}{\blacksquare} = \frac{30}{100}$
• *How are the two numerators related to each other?* Sample answer: The first numerator is half the second numerator.

BL • *Explain how you could check your answer.* Sample answer: $\frac{15}{50}$ simplifies to $\frac{3}{10}$, and $\frac{30}{100}$ also simplifies to $\frac{3}{10}$.
• *How could you solve this problem mentally?* Sample answer: Use the common percent 10%. Since 30% is 10% and there are ten 10%s in 100%, divide 15 by 3, which is 5. Then multiply 5 by 10 to obtain 50.

Need Another Example?
110 is 55% of what number? 200

4. **Use the percent proportion.**

AL • *Are you asked to find the percent, the part, or the whole?* the whole
• *What is the part?* 225 *What is the percent?* 75%

OL • *How would you set up the percent proportion?* $\frac{225}{\blacksquare} = \frac{75}{100}$
• *How are the two numerators related to each other?* Sample answer: The second numerator is one-third the first numerator.

BL • *Explain how you could check your answer.* Sample answer: Divide the part, 225, by the whole, 300: 225 ÷ 300 = 0.75. The decimal 0.75 is 75%. I could also draw a bar diagram to check my answer.
• *How could you solve this problem mentally?* Sample answer: 225 is three times 75. So, multiply 100 by 3 also, which yields 300.

Need Another Example?
310 is 40% of what number? 775

Example

5. Use the percent proportion.

AL • *What is the problem asking you to find?* the total mass of 100 pennies

• *What percent of a penny was copper?* 5%

• *What is the mass of the copper in 100 pennies?* 15 grams

OL • *What is the part?* 15 *What is the percent?* 5%

• *How would you set up the percent proportion?* $\frac{15}{\blacksquare} = \frac{5}{100}$

BL • *How many grams of the 100 pennies would be zinc? Explain.* 285 g; 95% of 300 grams is 285 grams

Need Another Example?
A horse consumes approximately 2% of its body weight in hay each day. If a horse consumes 18 pounds of hay each day, how much does the horse weigh? 900 lb

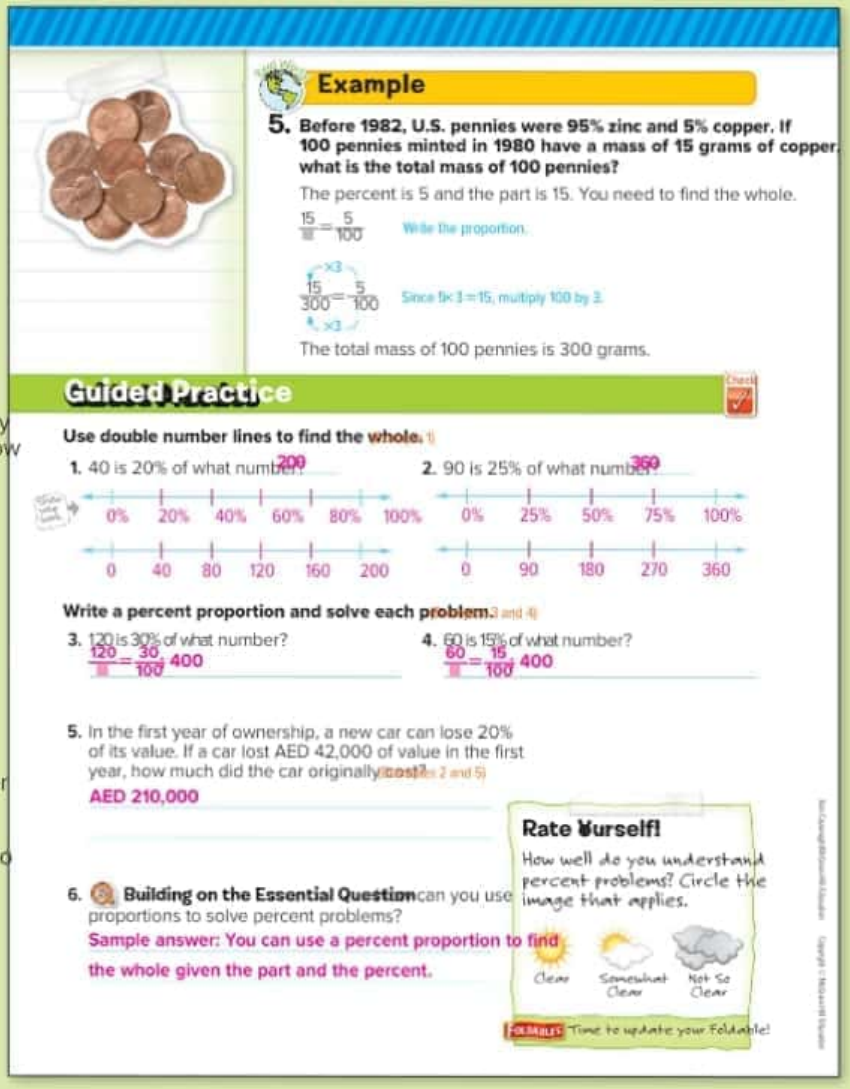
Guided Practice

Formative Assessment Use these exercises to assess students' understanding of the concepts in this lesson.

If some of your students are not ready for assignments, use the different strategies below.

AL LA **Pairs Discussion** For Exercises 1 and 2, have one student label the number line for the problem and the other label the number line for the parts of the whole. Have them discuss how the solution to the problem aligns on the number line. For Exercises 3–5, have one student write the ratio for percent, and the other the part and whole. Then have them combine their ratios to create a proportion and discuss how to use the proportion to determine the answer. MP 3, 5

BL LA **Pairs Present** Have pairs of students prepare a brief oral presentation showing how the double number line and proportion are related and how one can be determined from the other. MP 1, 3



Example

5. Before 1982, U.S. pennies were 95% zinc and 5% copper. If 100 pennies minted in 1980 have a mass of 15 grams of copper, what is the total mass of 100 pennies?

The percent is 5 and the part is 15. You need to find the whole.

$\frac{15}{\blacksquare} = \frac{5}{100}$ Write the proportion.

$\frac{15}{300} = \frac{5}{100}$ Since 5 × 3 = 15, multiply 100 by 3.

The total mass of 100 pennies is 300 grams.

Guided Practice

Use double number lines to find the whole. (1)

1. 40 is 20% of what number? 200

0% 20% 40% 60% 80% 100%
0 40 80 120 160 200

2. 90 is 25% of what number? 360

0% 25% 50% 75% 100%
0 90 180 270 360

Write a percent proportion and solve each problem. (3 and 4)

3. 120 is 30% of what number? $\frac{120}{\blacksquare} = \frac{30}{100}$ 400

4. 60 is 15% of what number? $\frac{60}{\blacksquare} = \frac{15}{100}$ 400

5. In the first year of ownership, a new car can lose 20% of its value. If a car lost AED 42,000 of value in the first year, how much did the car originally cost? (Examples 2 and 5)
AED 210,000

6. **Building on the Essential Question** How can you use proportions to solve percent problems?
Sample answer: You can use a percent proportion to find the whole given the part and the percent.

Rate Yourself!
How well do you understand percent problems? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

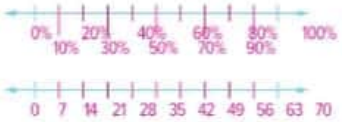
FOLDABLES Time to update your Foldable!

Name _____ My Homework _____

Independent Practice

Use double number lines to find the missing number.

1. 63 is 90% of what number? 70



2. 80 is 25% of what number? 320

Write a percent proportion and solve each problem. (Examples 3 and 4)

3. 22 is 44% of what number? $\frac{22}{\blacksquare} = \frac{44}{100}$ 50

4. 450 is 75% of what number? $\frac{450}{\blacksquare} = \frac{75}{100}$ 600

5. A store is having a sale where winter clothes are 60% of the original price. A sweater is on sale for AED 30. What was the original price of the sweater? (Examples 2 and 5)
AED 50

6. Khalifa calculates that he spends 15% of a school day in Science class. If he spends 75 minutes in Science class, how many minutes does Khalifa spend in school? (Examples 2 and 5) 500 minutes

For Exercises 7–9, use the table.

7. If you have 3 cups of pineapple juice, how many total cups of punch can you make? 15 cups

8. How many cups of sorbet are used in 8 cups of punch?
1.2 cups

9. Noura does not like sorbet, so she omits that ingredient and adds 5 percent of each of the other ingredients. How many cups of punch will she have if she uses 6 cups of orange juice? 20 cups

Punch Recipe	
Apple Juice	40%
Orange Juice	25%
Pineapple Juice	20%
Sorbet	15%

ENGAGE EXPLORE **EXPLAIN** ELABORATE EVALUATE

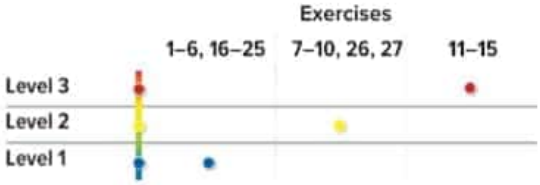
3 Practice and Apply

Independent Practice and Extra Practice

The Independent Practice pages are meant to be used as homework assignment. The Extra Practice page can be us for additional reinforcement or as a second-day assignmer

Levels of Complexity

The levels of the exercises progress from 1 to 3, with Level indicating the lowest level of complexity.



Suggested Assignments

You can use the table below that includes exercises of all complexity levels to select appropriate exercises for your students' needs.

Differentiated Homework Options		
AL	Approaching Level	1–7, 9, 11, 13, 14, 26, 27
OL	On Level	1–5 odd, 7–11, 13, 14, 26, 27
BL	Beyond Level	7–15, 26, 27

MATHEMATICAL PRACTICES

Emphasis On	Exercise(s)
1 Make sense of problems and persevere in solving them.	12, 15
2 Reason abstractly and quantitatively.	11
3 Construct viable arguments and critique the reasoning of others.	13, 14, 20
7 Look for and make use of structure.	10

Mathematical Practices 1, 3, and 4 are aspects of mathematical thinking that are emphasized in every lesson. Students are given opportunities to be persistent in their problem solving, to express their reasoning, and apply mathematics to real-world situations.

Formative Assessment
Use this activity as a closing formative assessment before dismissing students from your class.

TICKET Out the Door

Have students find the whole if the part is 126 and the percent is 90%. 140

Watch Out!

Common Error Students may incorrectly write one of the ratios in the percent proportion. Remind students that the percent proportion is written as a rate or ratio per 100. If the percent ratio is a proper fraction, the other ratio must also be a proper fraction.

10. **Identify Structure** Complete the following graphic organizers. Identify the missing information.

a. $\frac{3}{4}$ | part: 3 | whole: 4

b. 47% | part: 47% | whole: 100%

c. 12% of 225 | part: 12% | whole: 225

d. 120 out of 400 | part: 120 | whole: 400

e. How does identifying the part and the whole help you to write the percent proportion? Sample answer: In a percent proportion one ratio compares a part to the whole. The other ratio is the equivalent percent written as a fraction with a denominator of 100.

H.O.T. Problems Higher Order Thinking

11. **Reason Abstractly** Write a percent proportion where the part and the whole are known. Solve the problem to find the percent. Sample answer: $\frac{21}{25} = \frac{n}{100}$; 84

12. **Persevere with Problems** Using what you know about percents, explain why a commercial that says "80% of dentists use this toothpaste" might be misleading. Sample answer: The commercial would be misleading because only the percent is known. In order for the statement to have meaning, either the part or the whole must be known. Without knowing either of these, it could be 4 of 5 dentists, or 80 of 100 dentists surveyed.

13. **Reason Inductively** The purity of gold is listed in karats. Refer to the table. If a necklace is 75% gold, what karat is it? Explain your reasoning. 18 karats; 24 is the whole and 75 is the percent, so $\frac{18}{24} = \frac{75}{100}$

Karats	Pure Gold (%)
24	100
12	50

14. **Construct an Argument** Omar scored an 82% on his first test of the quarter. Will a score of 38 out of 50 on the second test help or hurt his grade? Explain your reasoning. It will hurt his grade. 38 out of 50 is 76%. If 76% and 82% are averaged, Omar's average grade is 79%, which is less than 82%.

15. **Persevere with Problems** At the zoo, an Asian elephant is about 3 tons and eats about 300 pounds of food a day. What percentage of its body weight does the elephant eat each day? 5%

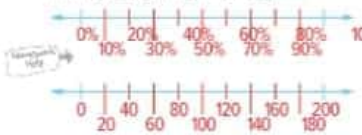
Name _____ My Homework _____

Extra Practice

Use double number lines to find the missing number.

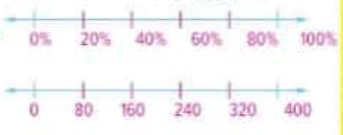
16. 140 is 70% of what number?

200



17. 240 is 60% of what number?

400



Write a percent proportion and solve each problem.

18. 95 is 95% of what number?

$\frac{95}{n} = \frac{95}{100}$; 100

19. 270 is 90% of what number?

$\frac{270}{n} = \frac{90}{100}$; 300

20. **Justify Conclusions** Action movies make up 85% of Salem's movie collection. If Salem has 20 movies, how many action movies are in Salem's collection? Explain your reasoning to a classmate.

17 movies; $\frac{n}{20} = \frac{85}{100}$. Since 100 ÷ 5 = 20, divide 85 by 5. 85 ÷ 5 = 17

21. The Drama club held a car wash ... Saturday. They washed a total ... If they washed 40% ... cars ... how many cars ... wash on Fr...

24 cars

22. A tiger can eat food that weighs up to 15% of its body weight. If a tiger can eat 75 pounds of food, how much does a tiger weigh?

500 lb

23. According to a survey, 12% of the students at an international school speak Russian. There are 36 students at the school who speak Russian. How many students were surveyed?

300 students

24. Miley's Music has a sale on music CDs. All music CDs are discounted 15%. Maysoun's receipt indicates that she saved AED 3 on her CD purchase. What is the full price of her music CD before the discount?

AED 20

25. The interior paint color, Melon Madness, is 30% yellow. Humaid used 72 ounces of yellow paint to mix the last batch. How many ounces of Melon Madness did he make in the last batch?

240 ounces

Power Up! Test Practice

Exercises 26 and 27 prepare students for more rigorous thinking needed for the assessment.

26.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practices	MP1, MP2
Scoring Rubric	
1 point	Students correctly answer each part of the question.

27.

This test item requires students to explain and apply mathematical concepts and solve problems with precision, while making use of structure.	
Depth of Knowledge	DOK1
Mathematical Practice	MP5
Scoring Rubric	
1 point	Students correctly answer the question.

Power Up! Test Practice

26. A 4-H club held a canned food drive. On Wednesday, they collected 63 cans, which was 21% of the total cans collected during the food drive. Complete the table to show the number of cans collected on Tuesday and Thursday.

Day	Percent of Total Collected	Number Cans
Tuesday	21	63
Wednesday	46	138
Thursday	33	99

27. Refer to the survey results shown. Suppose 150 students were surveyed. How many students chose Math as their favorite subject? **30 students**

Favorite Subject	
English	23%
Science	30%
Social Studies	15%
Math	■
Music	12%

Spiral Review

Find the equivalent fraction.

28. $\frac{84}{120} = \frac{7}{10}$

29. $\frac{60}{98} = \frac{30}{49}$

30. $\frac{40}{64} = \frac{5}{8}$

31. $\frac{32}{41} = \frac{96}{123}$

32. $\frac{13}{15} = \frac{52}{60}$

33. $\frac{24}{32} = \frac{12}{16}$

34. A store has a sale for $\frac{3}{10}$ off gloves. Write $\frac{3}{10}$ as a decimal.

0.3

35. Ali runs 0.75 mile each day. How far has he run at the end of 6 days?

4.5 miles

Ratios and Proportional Relationships

21ST CENTURY CAREER in Movies

Special Effects Animator

Are you fascinated by how realistic the special effects in movies are today? If you have creative talent and are good with computers, a career in special effects animation might be a great fit for you. Special effects animators use their artistic ability and expertise in computer-generated imagery (CGI) to simulate real-life objects like water and fire. They are also able to create fantastic images like flying superheroes, exploding asteroids, and monsters taking over cities.

Is This the Career for You?

Are you interested in a career as a special effects animator? Take some of the following courses in high school.

- Digital Animation
- Calculus
- Geometry
- Physics
- Art/Sculpture

Turn the page to find out how math relates to a career in Movies.

Focus narrowing the scope

Objective Apply mathematics to problems arising in the workplace.

This lesson emphasizes **Mathematical Practice 4** Model with Mathematics.

Coherence connecting within and across grades

Previous Students found the percent of a number.

Now Students apply the content standard to solve problems in the workplace.

Rigor pursuing concepts, fluency, and applications

See the Career Project on page 164.

ENGAGE EXPLORE EXPLAIN ELABORATE EVALUATE

1 Launch the Lesson

Ask students to read the information on the student page about special effects animators and answer the following questions.

Ask:

- *What kinds of abilities and interests do you need to be special effects animator?* creativity and interest in computers
- *What do special effects animators simulate?* real-world objects like water and fire; create images like monsters or superheroes

ENGAGE EXPLORE **EXPLAIN** **ELABORATE** EVALUATE

2 Collaborate

AL LA **Simultaneous Roundtable** Have students gather in pairs or in teams of four to complete Exercises 1–6. In teams, students each write a response for Exercises 1–6 on their own piece of paper. Students then pass their papers clockwise so each teammate can edit, or add to the prior response. After each paper returns to the original owner, have students discuss their results. MP 1, 3

BL LA **Numbered Heads Together** Assign students to 3- or 4-person learning teams. Each member is assigned a number from 1 to 4. Each team completes Exercises 1–6, making sure that every member understands. After they have completed the exercises, have them discuss the following questions as a team. MP 1, 3

Ask:

- *How can speaking aloud a decimal help you to write the decimal as a fraction?* Sample answer: Saying the decimal aloud helps you to correctly place the numerator and denominator of a fraction because the word form of the decimal includes the final place-value.
- *What is a method you can use to change a decimal to percent?* Sample answer: Multiply by 100. Add the % symbol.

Career Portfolio

When students complete this page, have them add it to their Career Portfolio.

The Effects are Amazing!

Special effects animators must specify when objects fade or change color. Table 1 shows when an object starts fading out. Table 2 shows the percent of an object's total lifetime that it has the initial color, cross-fading of colors, and the final color. Use the tables to solve each problem.

1. Express the part of total lifetime for each object in Table 1 as a fraction in simplest form. $\frac{18}{25}, \frac{6}{25}, \frac{13}{20}$
2. At what percent of the light beam's total lifetime does it begin to fade out? 65%
3. In Table 2, express the percents for the cross-fading of both objects as decimals. 0.15; 0.77
4. Which best describes the part of the robot's lifetime in which it has the initial color: $\frac{3}{100}$, $\frac{3}{10}$, or $\frac{3}{10}$? $\frac{3}{10}$
5. What fraction of the tornado's lifetime does it have the initial color? $\frac{3}{25}$
6. What fraction of the robot's lifetime does it have the final color? $\frac{11}{20}$

Table 1
Fading Out an Object

Object	Part of Total Lifetime
Explosion	0.72
Fog	0.24
Light beam	0.65

Table 2
Changing Color of an Object

Object	Percent of Total Lifetime		
	Initial Color	Cross-Fading	Final Color
Robot	30%	15%	55%
Tornado	12%	77%	11%

Career Project

It's time to update your career profile! Choose one of your favorite movies. Use the Internet to research how the movie's special effects were created. Write a brief description of the processes used by the special effects animators.

List several jobs that were created by the movie industry.

Chapter Review

Vocabulary Check

Unscramble each of the clue words. After unscrambling all of the terms, use the numbered letters to find the phrase.

INROALAT NUEMBR

R	A	T	I	O	N	A	L		N	U	M	B	E	R
10					6		9				12			1

TEEPNCR

P	E	R	C	E	N	T
						4

LESTA MOCNOM EOMITNORNAD

L	E	A	S	T		C	O	M	M	O	N		D	E	N	O	M	I	N	A	T	O	R
			8																				2

PIONORTOPR

P	R	O	P	O	R	T	I	O	N
					5		7		

CTREENP ROIPPTORNO

P	E	R	C	E	N	T		P	R	O	P	O	R	T	I	O	N
	11		3													13	

F	R	A	C	T	I	O	N	S		A	R	E		F	U	N
	1	2	3	4	5	6	7	8		9	10	11			12	13

Complete each sentence using one of the unscrambled words above.

1. A percent is a ratio that compares a number to 100.
2. A proportion is an equation that shows that two ratios are equivalent.
3. In a percent proportion, one ratio compares a part to a whole.
4. A number that can be written as a fraction is a rational number.
5. The least common denominator is the least common multiple of the denominators of two or more fractions.

Vocabulary Check

LA **Pairs Check** Have students work in pairs to complete the Vocabulary Check. One student unscrambles the clue word and completes a term. The other listens and coaches. Students switch roles for the next clue word and exercise. After every two terms, pairs check their answers with another pair and resolve any disagreements. MP.3, 5, 6

Alternate Strategy

AL LA To help students, you may wish to provide a vocabulary list from which they can choose terms. A vocabulary list for this activity would include these terms.

- least common denominator (Lesson 5)
- percent (Lesson 2)
- percent proportion (Lesson 8)
- proportion (Lesson 8)
- rational number (Lesson 1)

Key Concept Check

FOLDABLES LA A completed Foldable for this chapter should include a review of fractions, decimals, and percents.

If you choose not to use this Foldable, have students write a brief review of the Key Concepts found throughout the chapter and give an example of each.

Ideas for Use

LA **Three-Step Interview** Have students work in pairs to discuss their Foldables. Have them practice speaking in a collaborative setting by having Student 1 interview Student 2 on how they completed their Foldable thus far and how they could finish it, if needed. Then have Student 2 interview Student 1 using similar interview questions. Have them discuss and resolve any differences in how they each have completed their Foldable. MF 1, 3, 5

Got It?

If students have trouble with Exercises 1–3, they may need help with the following concept(s).

Concept	Exercise(s)
fractions as decimals (Lesson 1)	1
decimals as fractions (Lesson 1)	2
percents as fractions (Lesson 2)	3