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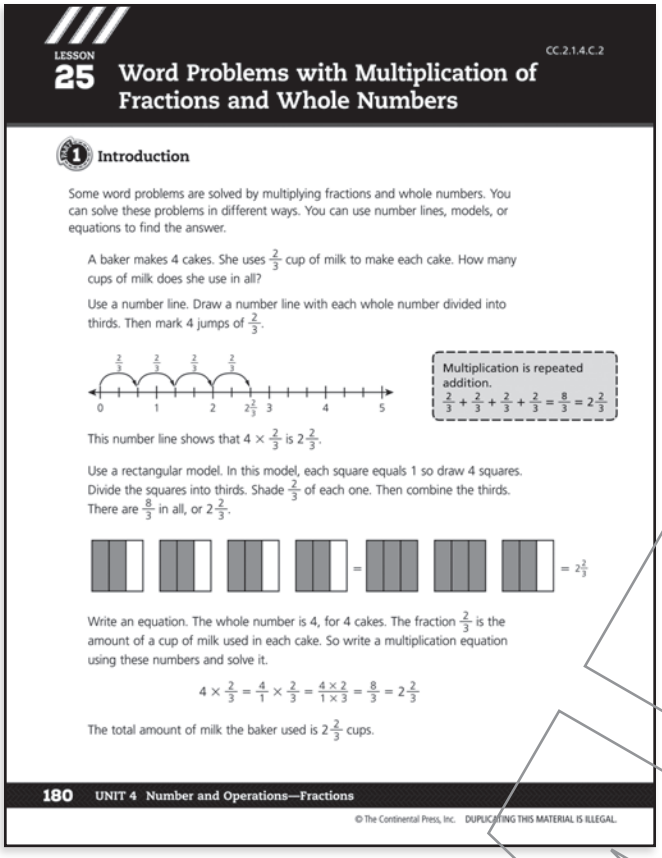
25 Word Problems with Multiplication of Fractions and Whole Numbers



LESSON 25

CC.2.1.4.C.2

Word Problems with Multiplication of Fractions and Whole Numbers

1 Introduction

Some word problems are solved by multiplying fractions and whole numbers. You can solve these problems in different ways. You can use number lines, models, or equations to find the answer.

A baker makes 4 cakes. She uses $\frac{2}{3}$ cup of milk to make each cake. How many cups of milk does she use in all?

Use a number line. Draw a number line with each whole number divided into thirds. Then mark 4 jumps of $\frac{2}{3}$.

Multiplication is repeated addition.
$\frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} = \frac{8}{3} = 2\frac{2}{3}$

This number line shows that $4 \times \frac{2}{3}$ is $2\frac{2}{3}$.

Use a rectangular model. In this model, each square equals 1 so draw 4 squares. Divide the squares into thirds. Shade $\frac{2}{3}$ of each one. Then combine the thirds. There are $\frac{8}{3}$ in all, or $2\frac{2}{3}$.

Write an equation. The whole number is 4, for 4 cakes. The fraction $\frac{2}{3}$ is the amount of a cup of milk used in each cake. So write a multiplication equation using these numbers and solve it.

$$4 \times \frac{2}{3} = \frac{4}{1} \times \frac{2}{3} = \frac{4 \times 2}{1 \times 3} = \frac{8}{3} = 2\frac{2}{3}$$

The total amount of milk the baker used is $2\frac{2}{3}$ cups.

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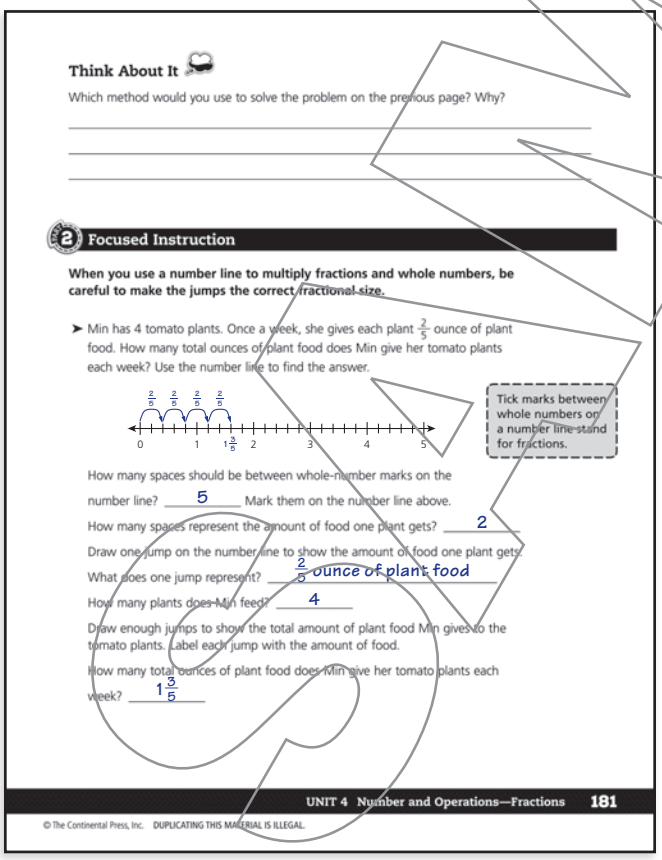

Think About It

Which method would you use to solve the problem on the previous page? Why?

2 Focused Instruction

When you use a number line to multiply fractions and whole numbers, be careful to make the jumps the correct fractional size.

➤ Min has 4 tomato plants. Once a week, she gives each plant $\frac{2}{5}$ ounce of plant food. How many total ounces of plant food does Min give her tomato plants each week? Use the number line to find the answer.

Tick marks between whole numbers on a number line stand for fractions.

How many spaces should be between whole-number marks on the number line? 5 Mark them on the number line above.

How many spaces represent the amount of food one plant gets? 2

Draw one jump on the number line to show the amount of food one plant gets.

What does one jump represent? $\frac{2}{5}$ ounce of plant food

How many plants does Min feed? 4

Draw enough jumps to show the total amount of plant food Min gives to the tomato plants. Label each jump with the amount of food.

How many total ounces of plant food does Min give her tomato plants each week? $1\frac{3}{5}$

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Objective

To solve word problems involving multiplication of fractions and mixed numbers

PART 1 Introduction

Review with students the kinds of situations that call for multiplication; they should know that combining multiples of a quantity is an instance of multiplication. Then discuss the methods by which the product of a fraction and a whole number can be found. Use the examples on the page to discuss the use of number lines and other models to show multiplication and how these representations can be translated into equations.

Think About It

Students' responses will vary; they should be supported with reasons.

PA Core Standard

CC.2.1.4.C.2 Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.

Eligible Content

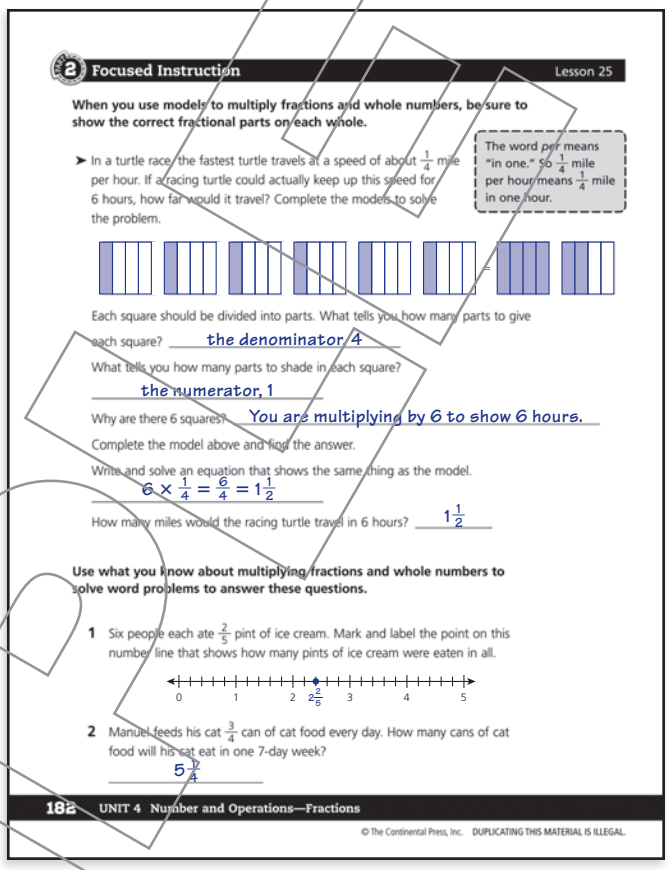
M04.A-F.2.1.7 Solve word problems involving multiplication of a whole number by a fraction (denominators limited to 2, 3, 4, 5, 6, 8, 10, 12, and 100).

Focused Instruction

In the first activity, students solve a multiplication problem by modeling it on the number line. The questions guide them to first mark the number line with fractional amounts. They then make each jump the size of the number multiplied and draw the same number of jumps as the whole number.

Next, students complete a model to represent a word problem. They recognize that the number of squares reflects the number multiplied by, so each square should be divided and shaded to reflect the number multiplied, $\frac{1}{4}$. They combine the shaded parts to find the product and then write and solve a number sentence that shows the same operation as the model.

Conclude the Focused Instruction section by having students solve two word problems involving multiplication of fractions.



Focused Instruction — Lesson 25

When you use models to multiply fractions and whole numbers, be sure to show the correct fractional parts on each whole.

➤ In a turtle race, the fastest turtle travels at a speed of about $\frac{1}{4}$ mile per hour. If a racing turtle could actually keep up this speed for 6 hours, how far would it travel? Complete the models to solve the problem.

The word *per* means "in one." So $\frac{1}{4}$ mile per hour means $\frac{1}{4}$ mile in one hour.

Each square should be divided into parts. What tells you how many parts to give each square? the denominator, 4

What tells you how many parts to shade in each square? the numerator, 1

Why are there 6 squares? You are multiplying by 6 to show 6 hours.

Complete the model above and find the answer.

Write and solve an equation that shows the same thing as the model.

$6 \times \frac{1}{4} = \frac{6}{4} = 1\frac{1}{2}$

How many miles would the racing turtle travel in 6 hours? $1\frac{1}{2}$

Use what you know about multiplying fractions and whole numbers to solve word problems to answer these questions.

1 Six people each ate $\frac{2}{5}$ pint of ice cream. Mark and label the point on this number line that shows how many pints of ice cream were eaten in all.

2 Manuel feeds his cat $\frac{3}{4}$ can of cat food every day. How many cans of cat food will his cat eat in one 7-day week?

$5\frac{1}{4}$

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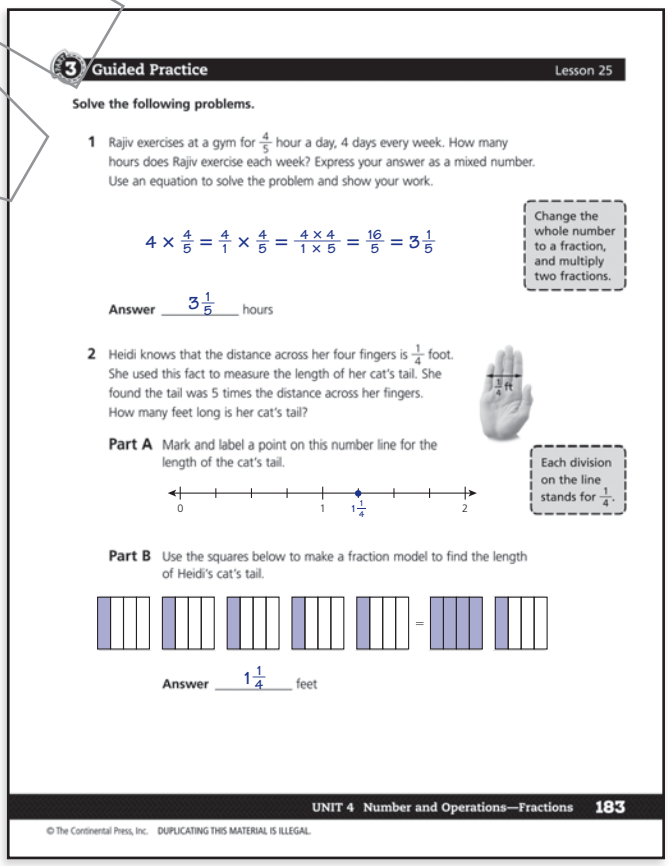
Guided Practice

Students should complete the Guided Practice section on their own. Offer assistance as needed, pointing out the reminder and hint boxes along the right side of the page.



Guided Practice — Lesson 25

Solve the following problems.

1 Rajiv exercises at a gym for $\frac{4}{5}$ hour a day, 4 days every week. How many hours does Rajiv exercise each week? Express your answer as a mixed number. Use an equation to solve the problem and show your work.

$4 \times \frac{4}{5} = \frac{4}{1} \times \frac{4}{5} = \frac{4 \times 4}{1 \times 5} = \frac{16}{5} = 3\frac{1}{5}$

Change the whole number to a fraction, and multiply two fractions.

Answer $3\frac{1}{5}$ hours

2 Heidi knows that the distance across her four fingers is $\frac{1}{4}$ foot. She used this fact to measure the length of her cat's tail. She found the tail was 5 times the distance across her fingers. How many feet long is her cat's tail?

Part A Mark and label a point on this number line for the length of the cat's tail.

Each division on the line stands for $\frac{1}{4}$.

Part B Use the squares below to make a fraction model to find the length of Heidi's cat's tail.

Answer $1\frac{1}{4}$ feet

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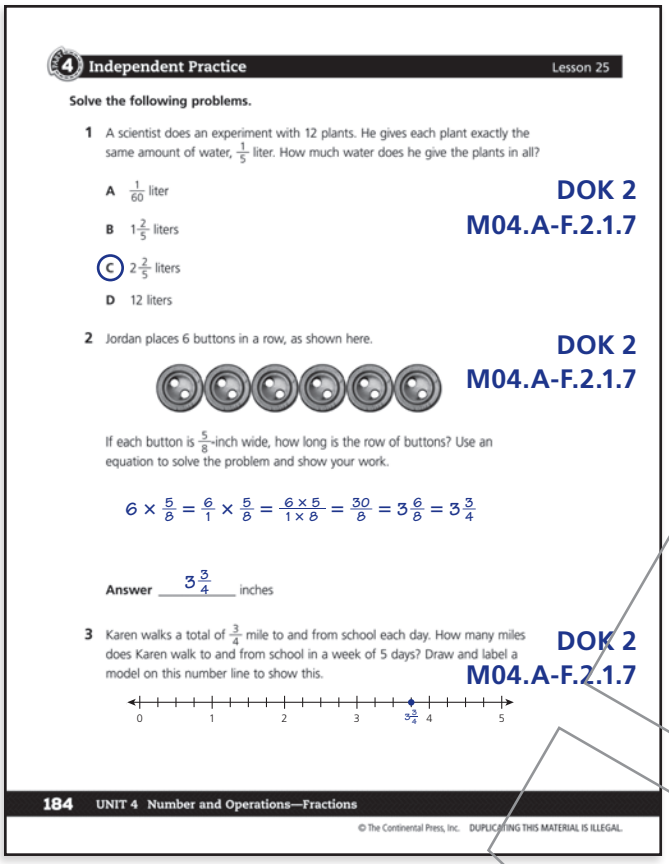
Extension Activity

Break the class into small groups and give each group one of the cards prepared for the Extension Activity in Lesson 24. Tell the students in each group to collaborate on writing a word problem that can be solved using the expression. For the multiplication expression $4 \times \frac{3}{4}$, for example, students might suggest "Jerzy practices trumpet for $\frac{3}{4}$ hour. He practiced 4 days this week. How many hours did Jerzy practice trumpet this week?" Collect the generated problems and share them with the class to solve.



Part 4 Independent Practice Lesson 25

Solve the following problems.

1 A scientist does an experiment with 12 plants. He gives each plant exactly the same amount of water, $\frac{1}{5}$ liter. How much water does he give the plants in all?

DOK 2
M04.A-F.2.1.7

A $\frac{1}{60}$ liter

B $1\frac{2}{5}$ liters

C $2\frac{2}{5}$ liters

D 12 liters

2 Jordan places 6 buttons in a row, as shown here.

DOK 2
M04.A-F.2.1.7

If each button is $\frac{5}{8}$-inch wide, how long is the row of buttons? Use an equation to solve the problem and show your work.

$6 \times \frac{5}{8} = \frac{6}{1} \times \frac{5}{8} = \frac{6 \times 5}{1 \times 8} = \frac{30}{8} = 3\frac{6}{8} = 3\frac{3}{4}$

Answer $3\frac{3}{4}$ inches

3 Karen walks a total of $\frac{3}{4}$ mile to and from school each day. How many miles does Karen walk to and from school in a week of 5 days? Draw and label a model on this number line to show this.

DOK 2
M04.A-F.2.1.7

0 1 2 3 $3\frac{3}{4}$ 4 5

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Part 4 Independent Practice Answer Rationales

1 To find the total amount of water, multiply the amount of water per plant by the number of plants: $12 \times \frac{1}{5} = \frac{12}{5} = 2\frac{2}{5}$ liters; choice C is correct. Choice A is incorrect; it multiplies the whole number and the denominator. Choice B is incorrect; it shows the product $\frac{12}{5}$ incorrectly converted to a mixed number as $1\frac{2}{5}$. Choice D is incorrect; it shows the number of plants used for the liters of water and reflects a misunderstanding of the problem.

2 The situation can be represented by a multiplication expression, 6 buttons $\times$ $\frac{5}{8}$-inch length = total length, or $6 \times \frac{5}{8}$. To find the product, multiply the whole number and numerator and write it above the denominator: $\frac{30}{8}$. Then simplify to a mixed number: $\frac{30}{8} = 3\frac{6}{8} = 3\frac{3}{4}$ inches.

3 A distance of $\frac{3}{4}$ mile is walked each day; this is the size of the jump, or the number multiplied. Therefore the number line should be divided with marks into fourths. If each mark represents $\frac{1}{4}$, then every third mark represents a distance of $\frac{3}{4}$ mile. Draw 5 jumps of $\frac{3}{4}$ mile for a total distance of $\frac{15}{4}$, or $3\frac{3}{4}$ miles.

Connections to Standards for Mathematical Practice

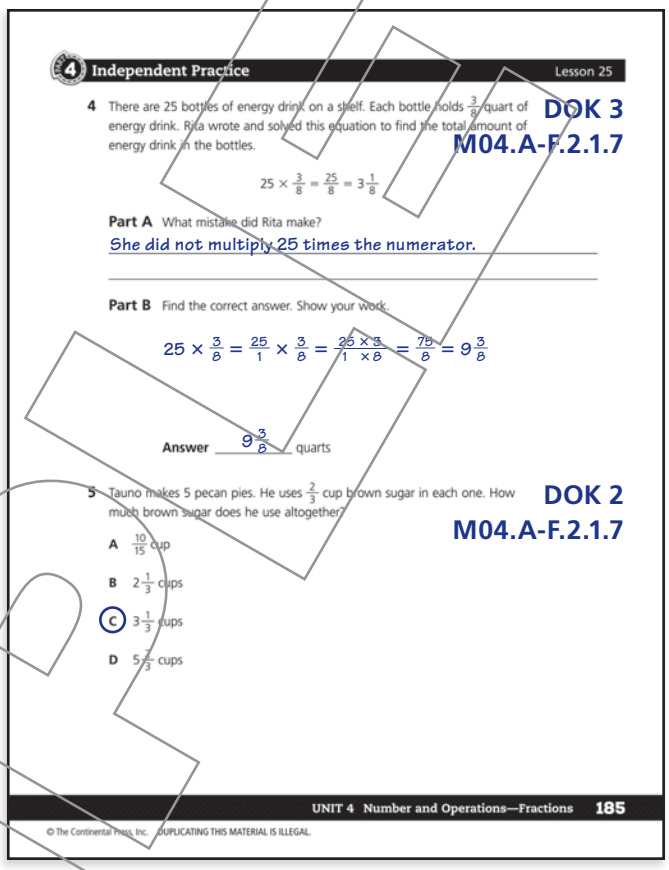
- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Model with mathematics.
- Look for and make use of structure.

4 PARTS A AND B To find the total amount of energy drink, multiply the amount in one bottle, $\frac{3}{8}$ quart, by the number of bottles, 25: $25 \times \frac{3}{8}$. Multiply the whole number and the numerator and write it over the denominator: $\frac{75}{8}$. Simplify as a mixed number: $9\frac{3}{8}$ quarts. Rita did not multiply the whole number numerator by the fractional numerator, rather she just put the whole number, 25, over the fractional denominator, 8.

5 Find the total amount of brown sugar by multiplying $5 \times \frac{2}{3} = \frac{5 \times 2}{3} = \frac{10}{3} = 3\frac{1}{3}$. Choice C is correct. Choice A is incorrect; it shows the result of multiplying both the numerator and denominator by the whole number, which is the same as multiplying by 1, and gives an equivalent fraction of $\frac{2}{3}$. Choice B is incorrect; it shows an error in converting the answer to a mixed number. Choice D is incorrect; it is the result of adding the factors, $\frac{5}{1} + \frac{2}{3} = 5\frac{2}{3}$, rather than multiplying them.

6 PART A The 3 rectangles represent the whole number (the number of times Boris runs), the number of divisions in each rectangle represents the denominator of the fraction, 6, and the number of shaded parts represents the numerator, 5. On the left side of the equal sign, complete the rectangles to show the fraction $\frac{5}{6}$ three times. On the right side, show the product $2\frac{3}{6}$, which is equivalent to $2\frac{1}{2}$.

PART B The equation that models the problem is $3 \times \frac{5}{6} = \frac{3 \times 5}{6} = \frac{15}{6} = 2\frac{3}{6} = 2\frac{1}{2}$.



4 Independent Practice Lesson 25

4 There are 25 bottles of energy drink on a shelf. Each bottle holds $\frac{3}{8}$ quart of energy drink. Rita wrote and solved this equation to find the total amount of energy drink in the bottles. DOK 3 M04.A-F.2.1.7

$25 \times \frac{3}{8} = \frac{25}{8} = 3\frac{1}{8}$

Part A What mistake did Rita make?

She did not multiply 25 times the numerator.

Part B Find the correct answer. Show your work.

$25 \times \frac{3}{8} = \frac{25}{1} \times \frac{3}{8} = \frac{25 \times 3}{1 \times 8} = \frac{75}{8} = 9\frac{3}{8}$

Answer $9\frac{3}{8}$ quarts

5 Tauno makes 5 pecan pies. He uses $\frac{2}{3}$ cup brown sugar in each one. How much brown sugar does he use altogether? DOK 2 M04.A-F.2.1.7

A $\frac{10}{15}$ cup

B $2\frac{1}{3}$ cups

C $3\frac{1}{3}$ cups

D $5\frac{2}{3}$ cups

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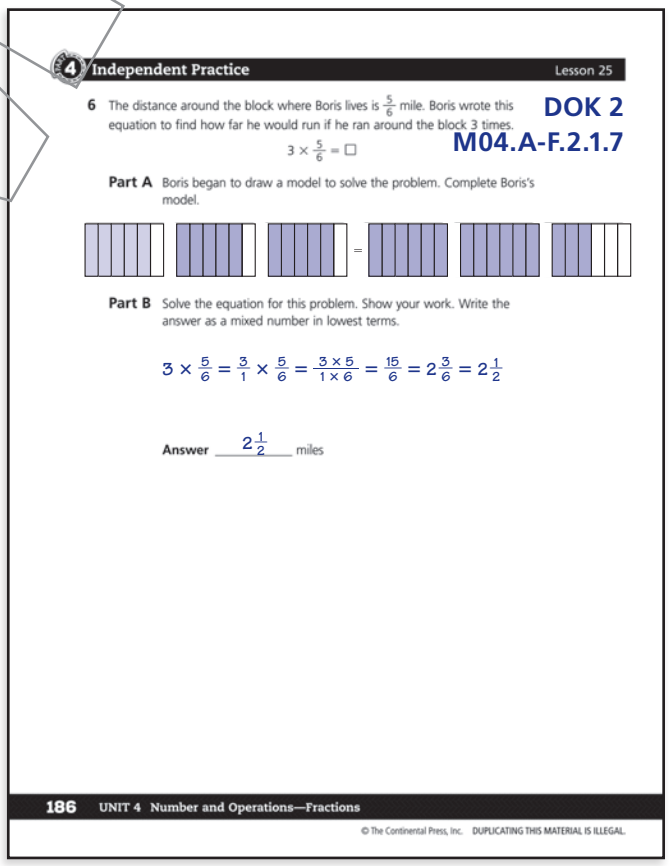

4 Independent Practice Lesson 25

6 The distance around the block where Boris lives is $\frac{5}{6}$ mile. Boris wrote this equation to find how far he would run if he ran around the block 3 times. DOK 2 M04.A-F.2.1.7

$3 \times \frac{5}{6} = \square$

Part A Boris began to draw a model to solve the problem. Complete Boris's model.

Part B Solve the equation for this problem. Show your work. Write the answer as a mixed number in lowest terms.

$3 \times \frac{5}{6} = \frac{3}{1} \times \frac{5}{6} = \frac{3 \times 5}{1 \times 6} = \frac{15}{6} = 2\frac{3}{6} = 2\frac{1}{2}$

Answer $2\frac{1}{2}$ miles

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