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Cover: mandritoiu/Shutterstock.com

Crosswalk: From the New York State Education Department. New York State Next Generation Mathematics Learning Standards Grade 5 Crosswalk. Internet. Available from www.nysed.gov/curriculum-instruction/teachers/next-generation-mathematics-learning-standards-crosswalks; accessed 8 January 2019.

ISBN 978-1-5240-1155-0



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# 3 Multiplying Fractions

PAGES 76 AND 77

## NYS NEXT GENERATION MATHEMATICS LEARNING STANDARDS

**5.NF.4** Apply and extend understanding of multiplication to multiply a fraction or whole number by a fraction.

**5.NF.4.a** Interpret the product $\frac{a}{b} \times q$ as $a$ parts of a partition of $q$ into $b$ equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$.

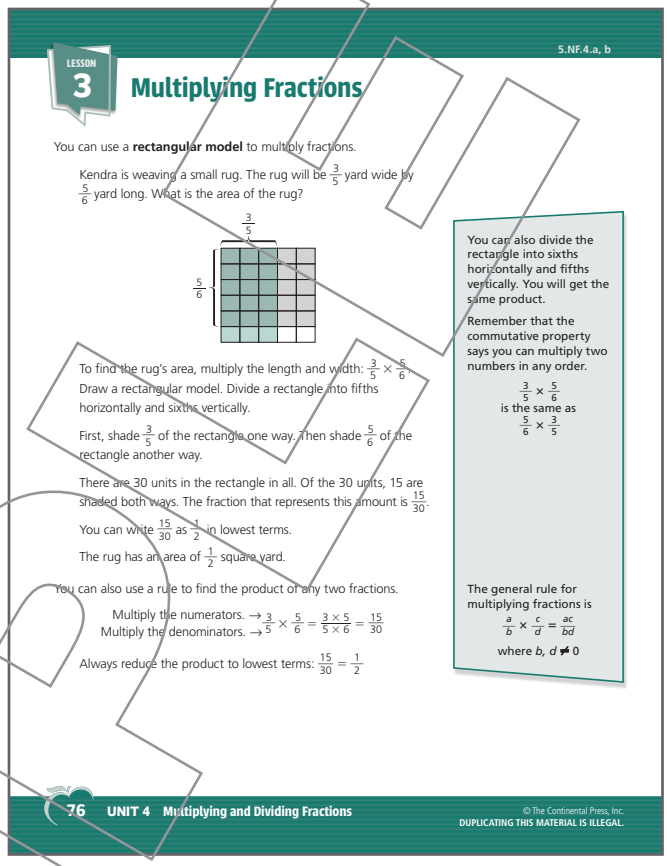
**5.NF.4.b** Find the area of a rectangle with fractional side lengths by tiling it with rectangles of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles and represent fraction products as rectangular areas.

## Introduction

The lesson reviews multiplying a fraction by a fraction and using fractional side lengths to find the area of rectangles. Read or have a volunteer read through the lesson and discuss the examples with the class. Guide students in understanding the relationship of fractional side lengths of a rectangle and the area as the product of those lengths. Remind them that area is expressed as square units.

## Guided Practice

The guided practice page provides sample multiple-choice and constructed answer problems for the students to complete on their own. Each item is accompanied by a hint or reminder that guides the student's thinking about how to solve the problem. Offer assistance as needed. When students have completed the items, review the answers and solution processes as a class.



5.NF.4.a, b

LESSON 3

### Multiplying Fractions

You can use a **rectangular model** to multiply fractions.

Kendra is weaving a small rug. The rug will be $\frac{3}{5}$ yard wide by $\frac{5}{6}$ yard long. What is the area of the rug?



To find the rug's area, multiply the length and width: $\frac{3}{5} \times \frac{5}{6}$.

Draw a rectangular model. Divide a rectangle into fifths horizontally and sixths vertically.

First, shade $\frac{3}{5}$ of the rectangle one way. Then shade $\frac{5}{6}$ of the rectangle another way.

There are 30 units in the rectangle in all. Of the 30 units, 15 are shaded both ways. The fraction that represents this amount is $\frac{15}{30}$.

You can write $\frac{15}{30}$ as $\frac{1}{2}$ in lowest terms.

The rug has an area of $\frac{1}{2}$ square yard.

You can also use a rule to find the product of any two fractions.

Multiply the numerators. → $\frac{3}{5} \times \frac{5}{6} = \frac{3 \times 5}{5 \times 6} = \frac{15}{30}$
Multiply the denominators. →

Always reduce the product to lowest terms: $\frac{15}{30} = \frac{1}{2}$

You can also divide the rectangle into sixths horizontally and fifths vertically. You will get the same product.

Remember that the commutative property says you can multiply two numbers in any order.

$\frac{3}{5} \times \frac{5}{6}$ is the same as $\frac{5}{6} \times \frac{3}{5}$

The general rule for multiplying fractions is $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$ where $b, d \neq 0$

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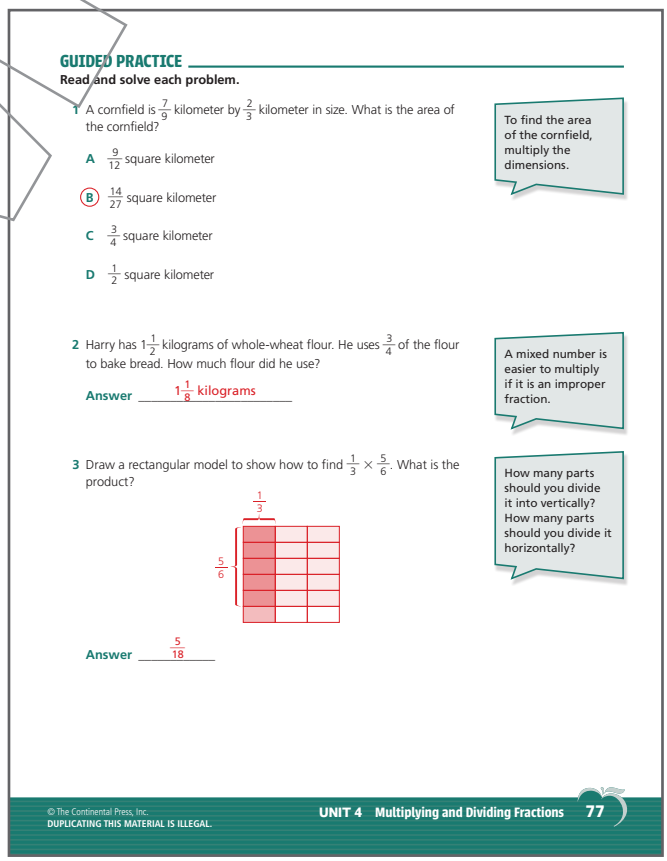

### GUIDED PRACTICE

**Read and solve each problem.**

**1** A cornfield is $\frac{7}{9}$ kilometer by $\frac{2}{3}$ kilometer in size. What is the area of the cornfield?

To find the area of the cornfield, multiply the dimensions.

A $\frac{9}{12}$ square kilometer

B $\frac{14}{27}$ square kilometer

C $\frac{3}{4}$ square kilometer

D $\frac{1}{2}$ square kilometer

**2** Harry has $1\frac{1}{2}$ kilograms of whole-wheat flour. He uses $\frac{3}{4}$ of the flour to bake bread. How much flour did he use?

A mixed number is easier to multiply if it is an improper fraction.

**Answer** $1\frac{1}{8}$ kilograms

**3** Draw a rectangular model to show how to find $\frac{1}{3} \times \frac{5}{6}$. What is the product?

How many parts should you divide it into vertically? How many parts should you divide it horizontally?



**Answer** $\frac{5}{18}$

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SAMPLE



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## Answer Rationales

**1.** To multiply fractions, multiply the numerators and multiply the denominators: $\frac{3}{5} \times \frac{2}{3} = \frac{3 \times 2}{5 \times 3} = \frac{6}{15}$. Reduce the product to lowest terms: $\frac{6}{15} = \frac{2}{5}$. Choice C is correct. Students may also choose to cancel common factors. ***(5.NF.4.a)***

**2.** Rafael runs $\frac{2}{5}$ of $\frac{3}{4}$ mile, so multiply: $\frac{2}{5} \times \frac{3}{4} = \frac{2 \times 3}{5 \times 4} = \frac{6}{20}$. Reduce the product to lowest terms: $\frac{6}{20} = \frac{3}{10}$. Rafael runs a distance of $\frac{3}{10}$ mile. Choice D is correct. Students may also choose to cancel common factors. ***(5.NF.4.a)***

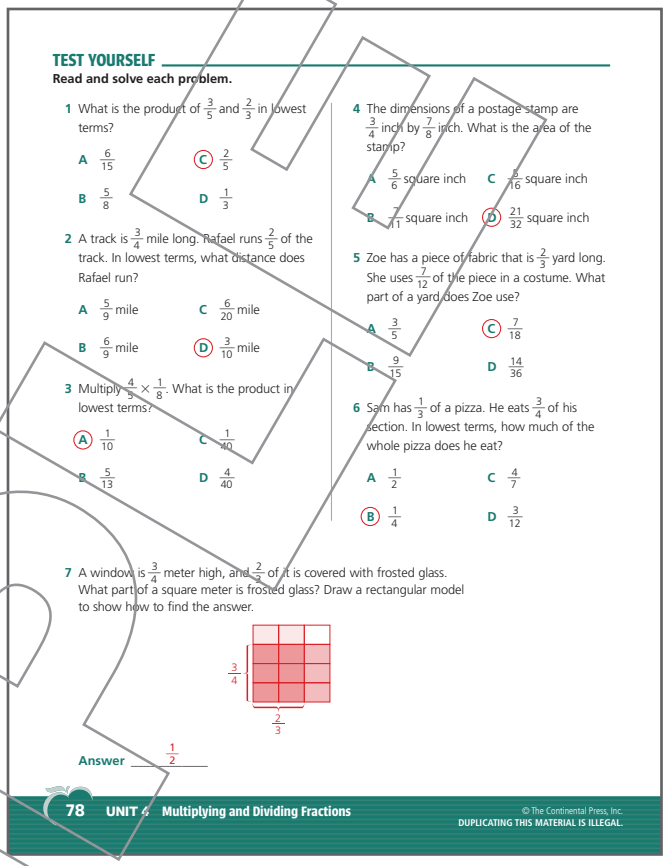
**3.** Multiply the numerators and multiply the denominators: $\frac{4}{5} \times \frac{1}{8} = \frac{\cancel{4}^{1} \times 1}{5 \times \cancel{8}_{2}} = \frac{1}{10}$. In lowest terms, the product is $\frac{1}{10}$; choice A is correct. ***(5.NF.4.a)***

**4.** To find the area, multiply length and width: $\frac{3}{4} \times \frac{7}{8} = \frac{3 \times 7}{4 \times 8} = \frac{21}{32}$. The area of the stamp is $\frac{21}{32}$ square inch. Choice D is correct. ***(5.NF.4.a, b)***

**5.** Zoe uses $\frac{7}{12}$ of $\frac{2}{3}$ yard of fabric. Multiply: $\frac{7}{12} \times \frac{2}{3} = \frac{7 \times \cancel{2}^{1}}{\cancel{12}_{6} \times 3} = \frac{7}{18}$. Zoe uses $\frac{7}{18}$ yard of fabric. Choice C is correct. ***(5.NF.4.a, b)***

**6.** Sam eats $\frac{3}{4}$ of $\frac{1}{3}$, so multiply: $\frac{3}{4} \times \frac{1}{3} = \frac{\cancel{3}^{1} \times 1}{4 \times \cancel{3}_{1}} = \frac{1}{4}$. Sam eats $\frac{1}{4}$ of the whole pizza. Choice B is correct. ***(5.NF.4.a)***

**7.** A rectangular model will show one dimension divided into fourths and three of them shaded and the other dimension divided into thirds and two of them shaded. This represents $\frac{2}{3}$ of $\frac{3}{4}$. The overlapping shaded parts represent the product, $\frac{1}{2}$ square meter. ***(5.NF.4.a, b)***



**TEST YOURSELF**

**Read and solve each problem.**

1 What is the product of $\frac{3}{5}$ and $\frac{2}{3}$ in lowest terms?

A $\frac{6}{15}$ (C) $\frac{2}{5}$

B $\frac{5}{8}$ D $\frac{1}{3}$

2 A track is $\frac{3}{4}$ mile long. Rafael runs $\frac{2}{5}$ of the track. In lowest terms, what distance does Rafael run?

A $\frac{5}{9}$ mile C $\frac{6}{20}$ mile

B $\frac{6}{9}$ mile (D) $\frac{3}{10}$ mile

3 Multiply $\frac{4}{5} \times \frac{1}{8}$. What is the product in lowest terms?

(A) $\frac{1}{10}$ C $\frac{1}{40}$

B $\frac{5}{13}$ D $\frac{4}{40}$

4 The dimensions of a postage stamp are $\frac{3}{4}$ inch by $\frac{7}{8}$ inch. What is the area of the stamp?

A $\frac{5}{6}$ square inch C $\frac{5}{16}$ square inch

B $\frac{7}{11}$ square inch (D) $\frac{21}{32}$ square inch

5 Zoe has a piece of fabric that is $\frac{2}{3}$ yard long. She uses $\frac{7}{12}$ of the piece in a costume. What part of a yard does Zoe use?

A $\frac{3}{5}$ (C) $\frac{7}{18}$

B $\frac{9}{15}$ D $\frac{14}{36}$

6 Sam has $\frac{1}{3}$ of a pizza. He eats $\frac{3}{4}$ of his section. In lowest terms, how much of the whole pizza does he eat?

A $\frac{1}{2}$ C $\frac{4}{7}$

(B) $\frac{1}{4}$ D $\frac{3}{12}$

7 A window is $\frac{3}{4}$ meter high, and $\frac{2}{3}$ of it is covered with frosted glass. What part of a square meter is frosted glass? Draw a rectangular model to show how to find the answer.

$\frac{3}{4}$ $\frac{2}{3}$

Answer $\frac{1}{2}$

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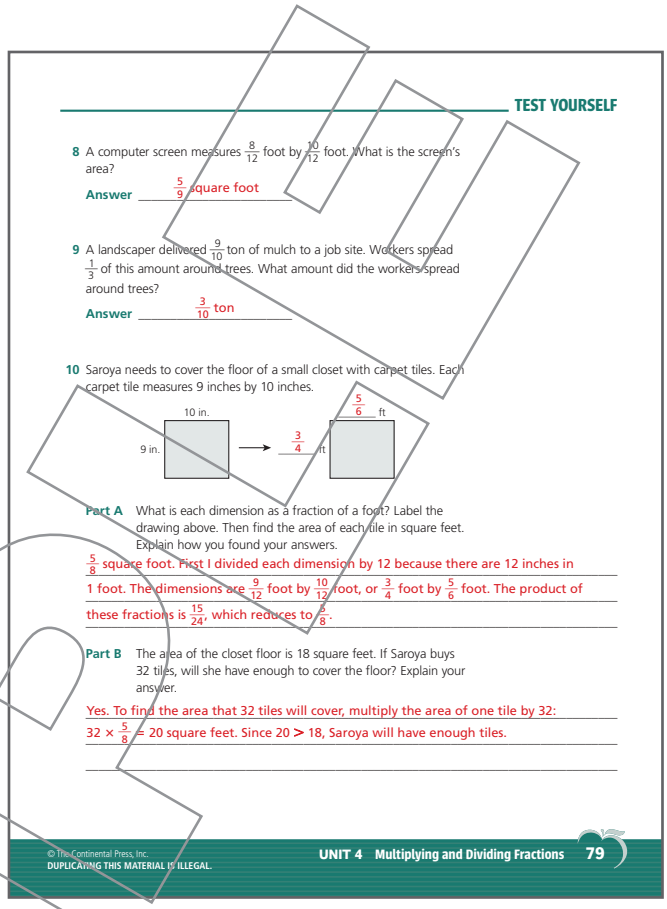
SAMPLE

**8.** Find area by multiplying the dimensions. First, simplify the fractions: $\frac{8}{12} = \frac{2}{3}$ and $\frac{10}{12} = \frac{5}{6}$. Multiply: $\frac{2}{3} \times \frac{5}{6} = \frac{{}^{1}\cancel{2} \times 5}{3 \times \cancel{6}_{3}} = \frac{5}{9}$. The area is $\frac{5}{9}$ square foot. ***(5.NF.4.a, b)***

**9.** Workers spread $\frac{1}{3}$ of the total amount of mulch, $\frac{9}{10}$ ton. Multiply: $\frac{1}{3} \times \frac{9}{10} = \frac{1 \times \cancel{9}^{3}}{{}_{1}\cancel{3} \times 10} = \frac{3}{10}$. The workers spread $\frac{3}{10}$ ton of mulch. ***(5.NF.4.a)***

**10. Part A** A foot is 12 inches, so 9 of 12 inches is $\frac{9}{12}$ or $\frac{3}{4}$ foot and 10 of 12 inches is $\frac{10}{12}$ or $\frac{5}{6}$ foot. To find the area in square feet, multiply the fractional dimensions: $\frac{3}{4} \times \frac{5}{6} = \frac{{}^{1}\cancel{3} \times 5}{4 \times \cancel{6}_{2}} = \frac{5}{8}$ square foot. ***(5.NF.4.a, b)***

**Part B** First find the area that 32 tiles will cover: $32 \times \frac{5}{8} = \frac{{}^{4}\cancel{32} \times 5}{{}_{1}\cancel{8}} = 4 \times 5 = 20$ square feet. Then compare this area to the area of the closet floor: $20 > 18$, so Saroya will have enough tiles to cover the floor. ***(5.NF.4.a, b)***



TEST YOURSELF

8 A computer screen measures $\frac{8}{12}$ foot by $\frac{10}{12}$ foot. What is the screen's area?

Answer $\frac{5}{9}$ square foot

9 A landscaper delivered $\frac{9}{10}$ ton of mulch to a job site. Workers spread $\frac{1}{3}$ of this amount around trees. What amount did the workers spread around trees?

Answer $\frac{3}{10}$ ton

10 Saroya needs to cover the floor of a small closet with carpet tiles. Each carpet tile measures 9 inches by 10 inches.

10 in. 9 in. → $\frac{3}{4}$ ft $\frac{5}{6}$ ft

Part A What is each dimension as a fraction of a foot? Label the drawing above. Then find the area of each tile in square feet. Explain how you found your answers.

$\frac{5}{8}$ square foot. First I divided each dimension by 12 because there are 12 inches in 1 foot. The dimensions are $\frac{9}{12}$ foot by $\frac{10}{12}$ foot, or $\frac{3}{4}$ foot by $\frac{5}{6}$ foot. The product of these fractions is $\frac{15}{24}$, which reduces to $\frac{5}{8}$.

Part B The area of the closet floor is 18 square feet. If Saroya buys 32 tiles, will she have enough to cover the floor? Explain your answer.

Yes. To find the area that 32 tiles will cover, multiply the area of one tile by 32: $32 \times \frac{5}{8} = 20$ square feet. Since $20 > 18$, Saroya will have enough tiles.

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SAMPLE

## CONNECTING TO MATHEMATICAL CONTENT

*Grade-span connections:*
4.NF.4 → 5.NF.5 → 6.G.1

*Grade-level connections:*
5.NBT.5 (multiplying whole numbers)
5.NBT.7 (multiplying decimals)

## CONNECTING TO MATHEMATICAL PRACTICES

*MP1:* Make sense of problems and persevere in solving them.

*MP2:* Reason abstractly and quantitatively.

*MP4:* Model with mathematics.


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