2.5 Multiplying Decimals
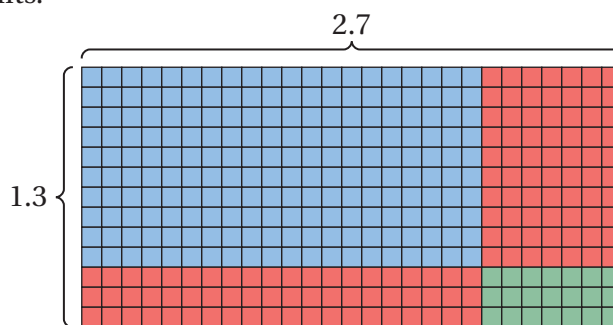
Essential Question How can you multiply decimals?

1 ACTIVITY: Multiplying Decimals Using a Rectangle

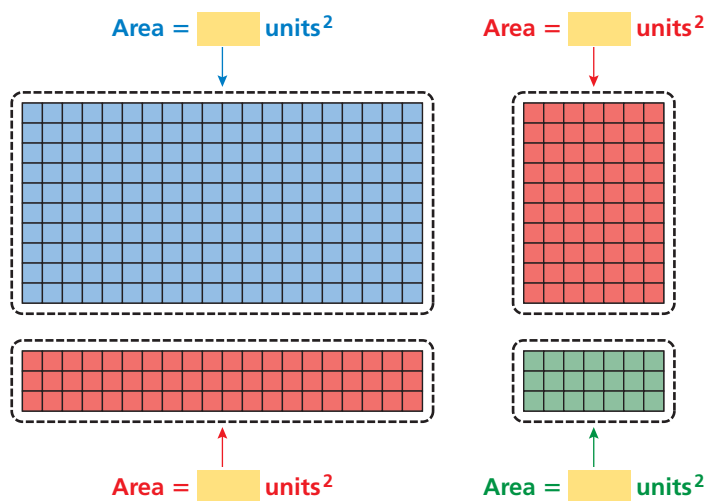**Work with a partner. Use a rectangle to find the product.**

a. $2.7 \cdot 1.3$

Arrange base ten blocks to form a rectangle of length 2.7 units and width 1.3 units.

2.7

1.3

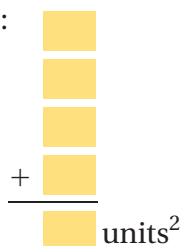The area of the rectangle represents the product.

Find the total area represented by each grouping of base ten blocks.

Area = [ ] units^2 Area = [ ] units^2

Area = [ ] units^2 Area = [ ] units^2

The area of the rectangle is:

[ ]
[ ]
[ ]
+ [ ]
_____
[ ] units^2

So, $2.7 \cdot 1.3 = $ [ ].

b. $1.8 \cdot 1.1$ **c.** $4.6 \cdot 1.2$ **d.** $3.2 \cdot 2.4$

2 ACTIVITY: Multiplying Decimals Using an Area Model

Work with a partner. Use an area model to find the product. Explain your reasoning.

a. $0.8 \cdot 0.5$
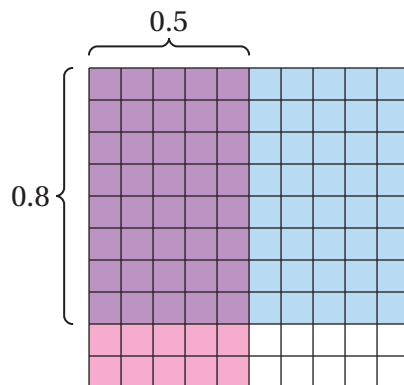
Because ☐ hundredths are shaded with both colors, the product is

$$\frac{\boxed{}}{100} = \boxed{}.$$

So, $0.8 \cdot 0.5 = \boxed{}$.

b. $0.3 \cdot 0.5$ **c.** $0.7 \cdot 0.6$ **d.** $0.2 \cdot 0.9$

3 ACTIVITY: Making a Conjecture

Work with a partner.

a. Find each product.

$27 \cdot 13$	$18 \cdot 11$	$46 \cdot 12$	$32 \cdot 24$
$8 \cdot 5$	$3 \cdot 5$	$7 \cdot 6$	$2 \cdot 9$

b. How are the numerical expressions in part (a) related to the numerical expressions in Activities 1 and 2? How are the products related?

c. **STRUCTURE** What conjecture can you make about the relationship between multiplying decimals and multiplying whole numbers?

What Is Your Answer?

4. IN YOUR OWN WORDS How can you multiply decimals?

Practice

Use what you learned about multiplying decimals to complete Exercises 9–12 on page 89.

2.5 Lesson

🔑 Key Idea

Multiplying Decimals by Whole Numbers

Words Multiply as you would with whole numbers. Then count the number of decimal places in the decimal factor. The product has the same number of decimal places.

Numbers
$$13.\underline{91}$$
$$\times \quad 7$$ → 2 decimal places
$$97.\underline{37}$$

$$6.\underline{218}$$
$$\times \quad 4$$ → 3 decimal places
$$24.\underline{872}$$

EXAMPLE 1 Multiplying Decimals and Whole Numbers

a. Find 6×3.91.

Estimate $6 \times 4 = 24$

$$\overset{5}{3.91} \leftarrow \boxed{\text{2 decimal places}}$$
$$\times \quad 6$$
$$23.46 \leftarrow \boxed{\text{Count 2 decimal places from right to left.}}$$

∴ So, $6 \times 3.91 = 23.46$.

Reasonable? $23.46 \approx 24$ ✓

b. Find 3×0.016.

Estimate $3 \times 0 = 0$

$$\overset{1}{0.016} \leftarrow \boxed{\text{3 decimal places}}$$
$$\times \quad 3$$
$$0.048 \leftarrow \boxed{\text{To have 3 decimal places, insert zeros to the left of 48.}}$$

∴ So, $3 \times 0.016 = 0.048$.

Reasonable? $0.048 \approx 0$ ✓

EXAMPLE 2 Use Mental Math

How high is a stack of 100 dimes?

1.35 millimeters

Method 1: Multiply 1.35 by 100.

$$1.35$$
$$\times 1\ 00$$
$$0\ 00$$
$$00\ 0$$
$$135$$
$$135.00$$

$\boxed{\text{2 decimal places}}$

Method 2: You are multiplying by a power of 10. Use mental math.

There are two zeros in 100. So, move the decimal point in 1.35 two places to the right.

$$1.35 \times 100 = 135. = 135$$

∴ So, a stack of 100 dimes is 135 millimeters high.

🔴 On Your Own

Now You're Ready
Exercises 13–24

Multiply. Use estimation to check your answer.

1. 12.3×8
2. 5×14.51
3. 0.88×9
4. 0.003×10

5. A quarter is 1.75 millimeters thick. How high is a stack of 1000 quarters? Solve using both methods.

The rule for multiplying two decimals is similar to the rule for multiplying a decimal by a whole number.

Key Idea

Multiplying Decimals by Decimals

Words Multiply as you would with whole numbers. Then add the number of decimal places in the factors. The sum is the number of decimal places in the product.

Numbers

$$
\begin{array}{r}
4.716 \leftarrow \quad \text{3 decimal places} \\
\times \quad 0.2 \leftarrow \quad +\text{ 1 decimal place} \\
\hline
0.9432 \leftarrow \quad \text{4 decimal places}
\end{array}
$$

EXAMPLE 3 Multiplying Decimals

a. Multiply 4.8×7.2.   **Estimate** $5 \times 7 = 35$

$$
\begin{array}{r}
4.8 \quad \longleftarrow \quad \text{1 decimal place} \\
\times 7.2 \quad \longleftarrow \quad +\text{ 1 decimal place} \\
\hline
9\,6 \\
3\,3\,6 \\
\hline
3\,4.5\,6 \quad \longleftarrow \quad \text{2 decimal places}
\end{array}
$$

So, $4.8 \times 7.2 = 34.56$.   **Reasonable?** $34.56 \approx 35$ ✓

b. Multiply 3.1×0.05.   **Estimate** $3 \times 0 = 0$

$$
\begin{array}{r}
3.1 \quad \longleftarrow \quad \text{1 decimal place} \\
\times 0.0\,5 \quad \longleftarrow \quad +\text{ 2 decimal places} \\
\hline
0.1\,5\,5 \quad \longleftarrow \quad \text{3 decimal places}
\end{array}
$$

So, $3.1 \times 0.05 = 0.155$.   **Reasonable?** $0.155 \approx 0$ ✓

On Your Own

Now You're Ready
Exercises 30–45

Multiply. Use estimation to check your answer.

6. 8.1×5.6 **7.** 2.7×9.04

8. 6.32×0.09 **9.** 1.785×0.2

EXAMPLE 4

Evaluating an Expression

What is the value of 2.44(4.5 − 3.175)?

Ⓐ 3.233   Ⓑ 3.599   Ⓒ 7.805   Ⓓ 32.33

Step 1: Subtract first because the minus sign is in parentheses.

$$
\begin{array}{r}
\overset{9}{4\,\cancel{10}\,\cancel{10}} \\
4.5\,\cancel{0}\,\cancel{0} \\
-\ 3.1\,7\,5 \\
\hline
1.3\,2\,5
\end{array}
$$

So, 2.44(4.5 − 3.175) = 2.44(1.325).

Step 2: Multiply the result from Step 1 by 2.44.

$$
\begin{array}{r}
1.3\,2\,5 \\
\times\ 2.4\,4 \\
\hline
5\,3\,0\,0 \\
5\,3\,0\,0 \\
2\,6\,5\,0 \\
\hline
3.2\,3\,3\,0\,0
\end{array}
$$

∴ The correct answer is Ⓐ.

🔴 On Your Own

Evaluate the expression.

10. 12.67 + 8.2 • 1.9   **11.** 6.4(1.8 • 7.5)

EXAMPLE 5

Real-Life Application

You buy 2.75 pounds of tomatoes. You hand the cashier a $10 bill. How much change will you receive?

Grapes
$1.99/pound

Tomatoes
$1.89/pound

Bananas
$0.49/pound
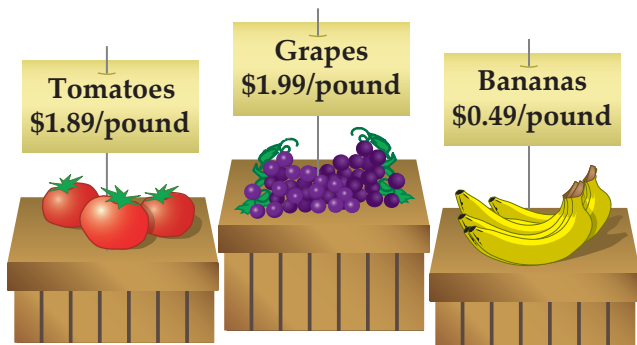
Step 1: Find the cost of the tomatoes. Multiply 1.89 by 2.75.

$$
\begin{array}{r}
1.8\,9 \quad \longleftarrow \text{2 decimal places}\\
\times\ 2.7\,5 \quad \longleftarrow +\text{ 2 decimal places}\\
\hline
9\,4\,5 \\
1\,3\,2\,3 \\
3\,7\,8 \\
\hline
5.1\,9\,7\,5 \quad \longleftarrow \text{4 decimal places}
\end{array}
$$

The cost of 2.75 pounds of tomatoes is $5.20.

Step 2: Subtract the cost of the tomatoes from the amount of money you hand the cashier.

10.00 − 5.20 = $4.80

∴ So, you will receive $4.80 in change.

🔴 On Your Own

12. **WHAT IF?** You buy 2.25 pounds of grapes. You hand the cashier a $5 bill. How much change will you receive?

✓ Vocabulary and Concept Check

1. **NUMBER SENSE** If you know $12 \times 24 = 288$, how can you find 1.2×2.4?

2. **NUMBER SENSE** Is the product 1.23×8 greater than or less than 8? Explain.

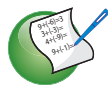**Copy the problem and place the decimal point in the product.**

3.
$$\begin{array}{r} 1.7\,8 \\ \times\ \ 4.9 \\ \hline 8\,7\,2\,2 \end{array}$$

4.
$$\begin{array}{r} 9.2\,4 \\ \times\ \ 0.6\,8 \\ \hline 6\,2\,8\,3\,2 \end{array}$$

5.
$$\begin{array}{r} 3.7\,5 \\ \times\ \ 5.2\,2 \\ \hline 1\,9\,5\,7\,5\,0 \end{array}$$

How many decimal places are in the product?

6. 6.17×8.2

7. 1.684×10.2

8. 0.053×2.78

Practice and Problem Solving

Use base ten blocks or an area model to find the product.

9.
$$\begin{array}{r} 2.1 \\ \times\ 1.5 \\ \hline \end{array}$$

10.
$$\begin{array}{r} 0.6 \\ \times\ 0.4 \\ \hline \end{array}$$

11.
$$\begin{array}{r} 0.7 \\ \times\ 0.3 \\ \hline \end{array}$$

12.
$$\begin{array}{r} 2.7 \\ \times\ 2.3 \\ \hline \end{array}$$

Multiply. Use estimation to check your answer.

① ② 13.
$$\begin{array}{r} 4.8 \\ \times\ \ 7 \\ \hline \end{array}$$

14.
$$\begin{array}{r} 6.3 \\ \times\ \ 5 \\ \hline \end{array}$$

15.
$$\begin{array}{r} 7.19 \\ \times\ \ 16 \\ \hline \end{array}$$

16.
$$\begin{array}{r} 0.87 \\ \times\ \ 21 \\ \hline \end{array}$$

17.
$$\begin{array}{r} 1.95 \\ \times\ \ 11 \\ \hline \end{array}$$

18.
$$\begin{array}{r} 5.89 \\ \times\ \ 5 \\ \hline \end{array}$$

19.
$$\begin{array}{r} 3.472 \\ \times\ \ 4 \\ \hline \end{array}$$

20.
$$\begin{array}{r} 8.188 \\ \times\ \ 12 \\ \hline \end{array}$$

21. 100×0.024

22. 19×0.004

23. 0.0038×9

24. 10×0.0093

ERROR ANALYSIS Describe and correct the error in the solution.

25.
✗
$$\begin{array}{r} 0.0045 \\ \times\ \ 9 \\ \hline 4.05 \end{array}$$

26.
✗
$$\begin{array}{r} 0.32 \\ \times\ \ 5 \\ \hline 0.160 \end{array}$$

27. **MOON** The weight of an object on the Moon is about 0.167 of its weight on Earth. How much does a 180-pound astronaut weigh on the Moon?

28. **BAMBOO** A bamboo plant grows about 1.25 feet each day. Find the growth in one week.

29. **NAILS** A fingernail grows about 0.1 millimeter each day. How much does a fingernail grow in 30 days? 90 days?

Multiply.

③ **30.** $\begin{array}{r} 0.7 \\ \times\ 0.2 \\ \hline \end{array}$ 　**31.** $\begin{array}{r} 0.08 \\ \times\ 0.3 \\ \hline \end{array}$ 　**32.** $\begin{array}{r} 0.007 \\ \times\ 0.03 \\ \hline \end{array}$ 　**33.** $\begin{array}{r} 0.0008 \\ \times\ 0.09 \\ \hline \end{array}$

34. $\begin{array}{r} 0.004 \\ \times\ 0.9 \\ \hline \end{array}$ 　**35.** $\begin{array}{r} 0.06 \\ \times\ 0.5 \\ \hline \end{array}$ 　**36.** $\begin{array}{r} 0.0008 \\ \times\ 0.004 \\ \hline \end{array}$ 　**37.** $\begin{array}{r} 0.0002 \\ \times\ 0.06 \\ \hline \end{array}$

38. 12.4×0.2 　**39.** 18.6×5.9 　**40.** 7.91×0.72 　**41.** 1.16×3.35

42. 6.478×18.21 　**43.** 1.9×7.216 　**44.** 0.0021×18.2 　**45.** 6.109×8.4

46. ERROR ANALYSIS Describe and correct the error in the solution.

$$✗\quad \begin{array}{r} 4.9 \\ \times\ 3.8 \\ \hline 186.2 \end{array}$$

47. TAKEOUT A Chinese restaurant offers buffet takeout for $4.99 per pound. How much does your takeout meal cost?

48. CROPLAND Alabama has about 2.51 million acres of cropland. Florida has about 1.15 times as much cropland as Alabama. How much cropland does Florida have?

49. GOLD On a tour of an old gold mine, you find a nugget containing 0.82 ounce of gold. Gold is worth $1566.80 per ounce. How much is your nugget worth?

50. BUILDING HEIGHTS One meter is approximately 3.28 feet. Find the height of each building in feet by multiplying its height in meters by 3.28.

Continent	Tallest Building	Height (meters)
Africa	Carlton Centre Office Tower	223
Asia	Burj Khalifa	828
Australia	Q1 Tower	323
Europe	The Shard	310
North America	Willis Tower	442
South America	Gran Torre	300

51. REASONING Show how to evaluate $7.12 \times 8.22 \times 100$ without multiplying the two decimals.

ORDER OF OPERATIONS Evaluate the expression.

④ **52.** $2.4 \times 16 + 7$ 　**53.** $6.85 \times 2 \times 10$ 　**54.** $1.047 \times 5 - 0.88$

55. $4.32(3.7 + 1.65)$ 　**56.** $23.98 - 1.7^2 \cdot 7.6$ 　**57.** $12 \cdot 5.16 + 10.064$

58. $0.9(8.2 \cdot 20.35)$ 　**59.** $7.5^2(6.084 - 5.44)$ 　**60.** $6.8 \cdot 2.18 \cdot 3.95$

61. REASONING Without multiplying, how many decimal places does 3.4^2 have? 3.4^3? 3.4^4? Explain your reasoning.

REPEATED REASONING Describe the pattern. Find the next three numbers.

62. 1, 0.6, 0.36, 0.216, . . .

63. 15, 1.5, 0.15, 0.015, . . .

64. 0.04, 0.02, 0.01, 0.005, . . .

65. 5, 7.5, 11.25, 16.875, . . .

66. FOOD You buy 2.6 pounds of apples and 1.475 pounds of peaches. You hand the cashier a $20 bill. How much change will you receive?

Apples
$1.23/pound

Peaches
$1.88/pound

67. MILEAGE A car can travel 22.36 miles on one gallon of gasoline.

  a. How far can the car travel on 8.5 gallons of gasoline?

  b. A hybrid car can travel 33.1 miles on one gallon of gasoline. How much farther can the hybrid car travel on 8.5 gallons of gasoline?

68. OPEN-ENDED You and four friends have dinner at a restaurant.

  a. Draw a restaurant menu that has main items, desserts, and beverages, with their prices.

  b. Write a guest check that shows what each of you ate. Find the subtotal.

  c. Multiply by 0.07 to find the tax. Then find the total.

  d. Round the total to the nearest whole number. Multiply by 0.20 to estimate a tip. Including the tip, how much did you spend?

GUEST CHECK

Check No. Table No. Order No. 240796 Server Name

Subtotal

Tax

Total

69. **Geometry** A rectangular painting has an area of 9.52 square feet.

  a. Draw three different ways in which this can happen.

  b. The cost of a frame depends on the perimeter of the painting. Which of your drawings from part (a) is the least expensive to frame? Explain your reasoning.

  c. The thin, black framing costs $1 per foot. The fancy framing costs $5 per foot. Will the fancy framing cost five times as much as the black framing? Explain why or why not.

  d. Suppose the cost of a frame depends on the outside perimeter of the frame. Does this change your answer to part (c)? Explain why or why not.

Fair Game Review What you learned in previous grades & lessons

Divide. *(Skills Review Handbook)*

70. 78 ÷ 3

71. 65 ÷ 13

72. 57 ÷ 19

73. 84 ÷ 12

74. MULTIPLE CHOICE How many edges does the rectangular prism at the right have? *(Skills Review Handbook)*

  (A) 4

  (B) 6

  (C) 8

  (D) 12