Algebra • Multiplication Patterns with Decimals

You can use patterns and place value to help you place the decimal point.

To multiply a number by a power of 10, you can use the exponent to determine how the position of the decimal point changes in the product.

	Exponent	Move decimal point:
$10^0 \times 5.18 = \underline{5.18}$	0	0 places to the right
$10^1 \times 5.18 = \underline{51.8}$	1	1 place to the right
$10^2 \times 5.18 = \underline{518}$	2	2 places to the right
$10^3 \times 5.18 = \underline{5,180}$	3	3 places to the right

You can use place-value patterns to find the product of a number and the decimals 0.1 and 0.01.

	Multiply by:	Move decimal point:
$1 \times 2,457 = \underline{2,457}$	1	0 places to the left
$0.1 \times 2,457 = \underline{245.7}$	0.1	1 place to the left
$0.01 \times 2,457 = \underline{24.57}$	0.01	2 places to the left

Complete the pattern.

1. $10^0 \times 25.89 =$ _____

$10^1 \times 25.89 =$ _____

$10^2 \times 25.89 =$ _____

$10^3 \times 25.89 =$ _____

2. $1 \times 182 =$ _____

$0.1 \times 182 =$ _____

$0.01 \times 182 =$ _____

Extending Multiplication Patterns

Use patterns to find the products.

1. $100 \times 0.95 =$ _____

$1,000 \times 0.95 =$ _____

$10,000 \times 0.95 =$ _____

$100,000 \times 0.95 =$ _____

$1,000,000 \times 0.95 =$ _____

2. $1 \times 2,689 =$ _____

$0.1 \times 2,689 =$ _____

$0.01 \times 2,689 =$ _____

$0.001 \times 2,689 =$ _____

$0.0001 \times 2,689 =$ _____

3. $2 \times 4 =$ _____

$20 \times 4 =$ _____

$200 \times 4 =$ _____

$2,000 \times 4 =$ _____

$20,000 \times 4 =$ _____

4. $30 \times 8 =$ _____

$3 \times 8 =$ _____

$0.3 \times 8 =$ _____

$0.03 \times 8 =$ _____

5. _____ $\times 4 = 12$

_____ $\times 4 = 120$

_____ $\times 4 = 1,200$

_____ $\times 4 = 12,000$

_____ $\times 4 = 120,000$

6. $10 \times 7 =$ _____

$1.0 \times 7 =$ _____

$0.1 \times 7 =$ _____

$0.01 \times 7 =$ _____

$0.001 \times 7 =$ _____

7. **Write Math** ▶ **Explain** how you used patterns to complete Exercise 3.

_____

_____

_____

8. Stretch Your Thinking Suppose you continue the pattern in Exercise 4. What will be the next three products?

_____

Multiply Decimals and Whole Numbers

You can draw a quick picture to help multiply a decimal and a whole number.

Find the product. 4×0.23

Draw a quick picture. Each bar represents one tenth, or 0.1.
Each circle represents one hundredth, or 0.01.

Step 1
Draw __4__ groups of __2__ tenths and __3__ hundredths.

Step 2
Combine the tenths. Then combine the hundredths.

Step 3
There are __12__ hundredths. Rename __10__ hundredths as __1__ tenth. Then you will have __9__ tenths and __2__ hundredths.

So, $4 \times 0.23 =$ __0.92__.

Find the product. Draw a quick picture.

1. $2 \times 0.19 =$ _____

2. $3 \times 0.54 =$ _____

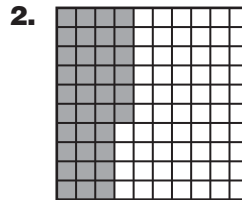**3.** $4 \times 0.07 =$ _____

4. $3 \times 1.22 =$ _____

One Product, Two Multiplication Sentences

The shaded squares in each decimal model represent the product of a whole number and a decimal. For each model, write two multiplication sentences whose products correspond to the model. The first one has been done for you.
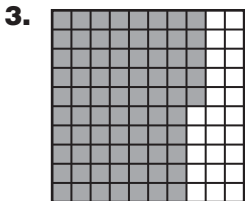
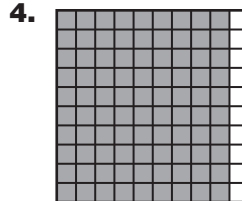**1.**

$8 \times 0.03 = 0.24$

$2 \times 0.12 = 0.24$

2.

_____

_____

3.

_____

_____
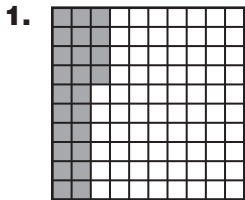
4.

_____

_____

5. Stretch Your Thinking Shade your own decimal model to represent the product of a whole number and a decimal. Then challenge a classmate to write two multiplication sentences for your model.

Name _____

Multiplication with Decimals and Whole Numbers

To find the product of a one-digit whole number and a decimal, multiply as you would multiply whole numbers. To find the number of decimal places in the product, add the number of decimal places in the factors.

To multiply 6 × 4.25, multiply as you would multiply 6 × 425.

Step 1
Multiply the ones.

$$\begin{array}{r} {\scriptstyle 3} \\ 425 \\ \times\ \ \ 6 \\ \hline 0 \end{array}$$

Step 2
Multiply the tens.

$$\begin{array}{r} {\scriptstyle 1\ 3} \\ 425 \\ \times\ \ \ 6 \\ \hline 50 \end{array}$$

Step 3
Multiply the hundreds. Then place the decimal point in the product.

$$\begin{array}{r} {\scriptstyle 1\ 3} \\ 4.25 \longleftarrow \mathbf{2}\ \textbf{decimal places} \\ \times\ \ \ 6 \longleftarrow +\mathbf{0}\ \textbf{decimal places} \\ \hline 25.50 \longleftarrow \mathbf{2}\ \textbf{decimal places} \end{array}$$

So, 6 × 4.25 = **25.50**.

Place the decimal point in the product.

1.
$$\begin{array}{r} 8.23 \\ \times\ \ \ 6 \\ \hline 4\ 9.3\ 8 \end{array}$$
Think: The place value of the decimal factor is hundredths.

2.
$$\begin{array}{r} 6.3 \\ \times\ \ \ 4 \\ \hline 2\ 5\ 2 \end{array}$$

3.
$$\begin{array}{r} 16.82 \\ \times\ \ \ \ 5 \\ \hline 8\ 4\ 1\ 0 \end{array}$$

Find the product.

4.
$$\begin{array}{r} 5.19 \\ \times\ \ \ 3 \\ \hline \end{array}$$

5.
$$\begin{array}{r} 7.2 \\ \times\ \ \ 8 \\ \hline \end{array}$$

6.
$$\begin{array}{r} 37.46 \\ \times\ \ \ \ 7 \\ \hline \end{array}$$

Connecting Decimal Multiplication and Division

Write a related multiplication sentence to find the unknown value that makes each statement true.

1. _____ ÷ 6 = 0.2

2. _____ ÷ 7 = 0.5

3. _____ ÷ 7 = 0.07

4. _____ ÷ 5 = 0.05

5. _____ ÷ 8 = 9.1

6. _____ ÷ 5 = 26.72

7. Write Math ➤ **Explain** how you can use the relationship between multiplication and division to complete Exercise 1.

_____

_____

_____

8. Stretch Your Thinking How could you find the value that makes the statement 32.2 ÷ ▮ = 4.6 true?

_____

_____

_____

_____

Multiply Using Expanded Form

You can use a model and partial products to help you find the product of a two-digit whole number and a decimal.

Find the product. 13×6.8

Step 1 Draw a large rectangle. Label its longer side **13** and its shorter side **6.8**. The area of the large rectangle represents the product, **13** $\times$ **6.8**.

Area $= 10 \times 6$

6.8
6   0.8

10   60
13

3

Step 2 Rewrite the factors in expanded form. Divide the large rectangle into four smaller rectangles. Use the expanded forms to label the smaller rectangles.

$13 =$ **10** $+$ **3** $6.8 =$ **6** $+$ **0.8**

Step 3 Multiply to find the area of each small rectangle.

$10 \times 6 =$ **60** $10 \times 0.8 =$ **8** $3 \times 6 =$ **18** $3 \times 0.8 =$ **2.4**

Step 4 Add to find the total area.

60 $+$ **8** $+$ **18** $+$ **2.4** $=$ **88.4**

So, $13 \times 6.8 =$ **88.4**.
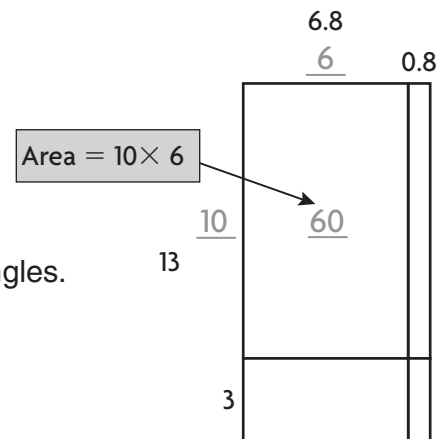
Draw a model to find the product.

1. $18 \times 0.25 =$ _____

2. $26 \times 7.2 =$ _____
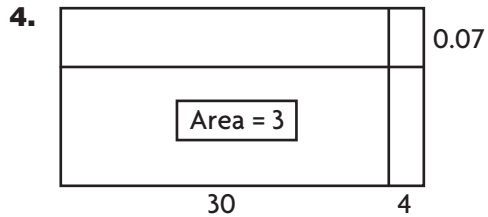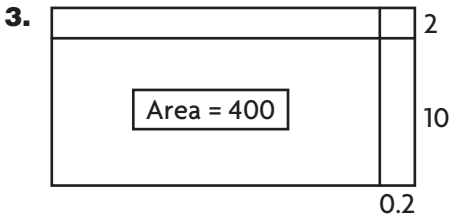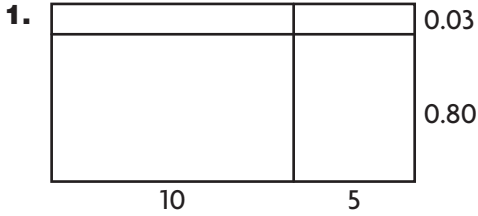
Find the product.

3. $17 \times 9.3 =$ _____

4. $21 \times 43.5 =$ _____

5. $48 \times 4.74 =$ _____

Analyzing Models and Partial Products

**Write the multiplication expression represented by the model.
Then find the product.**

1.

	0.03
	0.80
10	5

_____

2.

	0.07
	0.40
20	1

_____

3.

	2
Area = 400	10
0.2	

_____

4.

	0.07
Area = 3	
30	4

_____

5. **Write Math** ▶ Look back at Exercise 3. **Explain** how you used the given area of the smaller rectangle to help you write the multiplication expression the model represents.

_____

_____

_____

_____

_____

Name _____

Problem Solving • Multiply Money

Three students in the garden club enter a pumpkin-growing contest. Jessie's pumpkin is worth $12.75. Mara's pumpkin is worth 4 times as much as Jessie's. Hayden's pumpkin is worth $22.25 more than Mara's. How much is Hayden's pumpkin worth?

Read the Problem	Solve the Problem
What do I need to find? I need to find **how much Hayden's pumpkin is worth**.	The amount that Hayden's and Mara's pumpkins are worth depends on how much Jessie's pumpkin is worth. Draw a diagram to compare the amounts without calculating. Then use the diagram to find how much each person's pumpkin is worth.
What information do I need to use? I need to use the worth of **Jessie's** pumpkin to find how much **Mara's** and **Hayden's** pumpkins are worth.	Jessie $12.75 Mara $12.75 $12.75 $12.75 $12.75 Hayden $12.75 $12.75 $12.75 $12.75 $22.25
How will I use the information: I can draw a diagram to show **how much Jessie's and Mara's pumpkins are worth to find how much Hayden's pumpkin is worth**.	**Jessie:** $12.75 **Mara:** $4 \times$ **$12.75** = **$51.00** **Hayden:** **$51.00** + $22.25 = **$73.25**

So Hayden's pumpkin is worth **$73.25**.

1. Three friends go to the local farmers' market. Latasha spends $3.35. Helen spends 4 times as much as Latasha. Dee spends $7.50 more than Helen. How much does Dee spend?

2. Alexia raises $75.23 for a charity. Sue raises 3 times as much as Alexia. Manuel raises $85.89. How much money do the three friends raise for the charity in all?

_____ _____

Money Multiplication Problems

**Write a problem that can be represented by the model.
Then solve the problem.**

1. **T-shirt** $15.49

    Sunglasses | $15.49 | $3.80 |

_____

_____

_____

2. **Lemonade** $3.50

    Salad | $3.50 | $3.50 | $3.50 | $3.50 |

_____

_____

_____

3. **Mia** $5.25

    Madison | $5.25 | $5.25 |

    Morgan | $5.25 | $5.25 | $10.89 |

_____

_____

_____

4. **June** $28.50

    July | $28.50 | $28.50 | $28.50 |

    August | $28.50 | $28.50 | $28.50 | $17.75 |

_____

_____

_____

5. **Write Math** ➤ In Exercise 1, suppose you have $41. Would you have enough money to buy the items in the problem and two pairs of socks at $2.75 each? **Explain**.

_____

_____

_____

Decimal Multiplication

You can use decimal squares to multiply decimals.

Multiply. 0.2 × 0.9

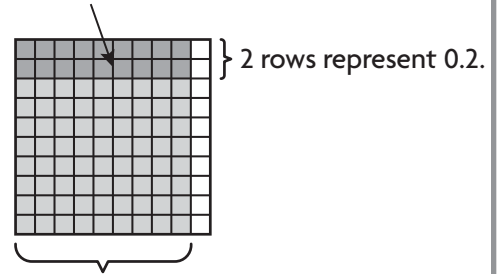**Step 1** Draw a square with 10 equal rows and 10 equal columns.

Step 2 Shade 9 columns to represent **0.9**.

Step 3 Shade 2 rows to represent **0.2**.

Step 4 Count the number of small squares where the shadings overlap: **18** squares, or 0.18.

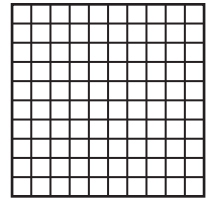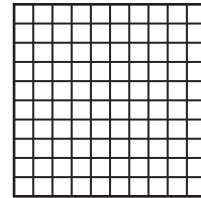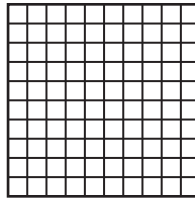So, 0.2 × 0.9 = **0.18**.

The shadings overlap in 18 squares, or 0.18.

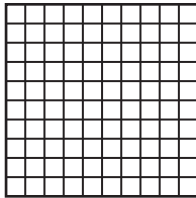} 2 rows represent 0.2.

9 columns represent 0.9.

Multiply. Use the decimal model.

1. 0.3 × 0.2 = _____

2. 0.9 × 0.5 = _____

3. 0.1 × 1.8 = _____

4. 0.4 × 0.4 = _____

5. 0.6 × 0.5 = _____

6. 0.4 × 1.2 = _____
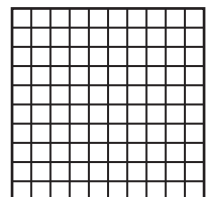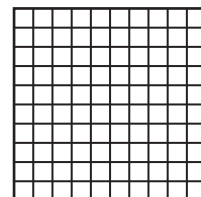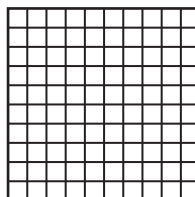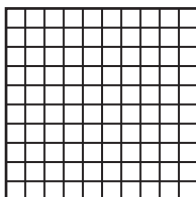
Backward Decimal Multiplication
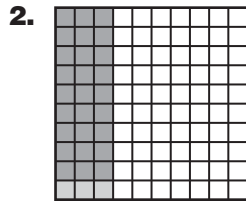
Write the multiplication equation that is represented by the model.
Each equation should include the factors and their product.

1.

_____

2.

_____

3.

_____

4.

_____

5.

_____

6.

_____
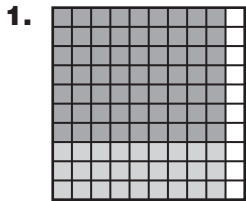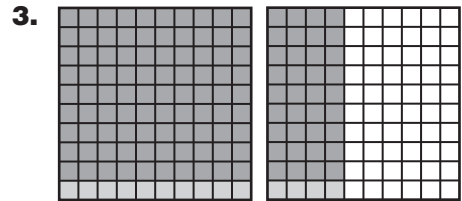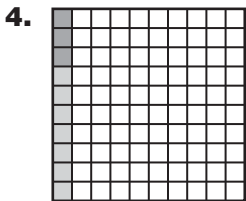
7. **Write Math** ▶ In Exercise 6, explain how you found the multiplication equation that the model represents.

_____

_____

_____

_____

8. **Stretch Your Thinking** How can you use decimal squares to represent the product 0×0.7? What is the product?

_____

_____

_____

Multiply Decimals

Multiply. 9.3 × 5.27

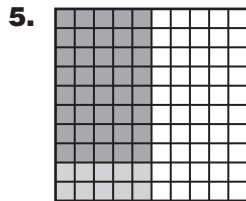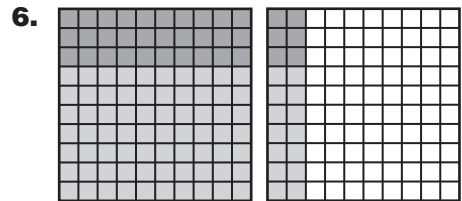**Step 1** Multiply as with whole numbers.

$$
\begin{array}{r}
^{2\ 6}\\
^{2}\\
527\\
\times\ \ \ 93\\
\hline
1{,}581\\
+\ 47{,}430\\
\hline
49{,}011
\end{array}
$$

Step 2 Add the number of decimal places in the factors
to place the decimal point in the product.

$$
\begin{array}{r}
5.27 \longleftarrow \ \underline{2}\ \text{decimal places}\\
\times\ 9.3 \longleftarrow +\underline{1}\ \text{decimal place}\\
\hline
1{,}581\\
+\ 47{,}430\\
\hline
49.011 \longleftarrow \ \underline{3}\ \text{decimal places}
\end{array}
$$

So, 9.3 × 5.27 = **49.011** .

Place the decimal point in the product.

1.
$$
\begin{array}{r}
1.6\\
\times\ 0.7\\
\hline
1\ 1\ 2
\end{array}
$$

2.
$$
\begin{array}{r}
14.2\\
\times\ 7.6\\
\hline
1\ 0\ 7\ 9\ 2
\end{array}
$$

3.
$$
\begin{array}{r}
3.59\\
\times\ 4.8\\
\hline
1\ 7\ 2\ 3\ 2
\end{array}
$$

Find the product.

4.
$$
\begin{array}{r}
5.7\\
\times\ 0.8\\
\hline
\end{array}
$$

5.
$$
\begin{array}{r}
35.1\\
\times\ 8.4\\
\hline
\end{array}
$$

6.
$$
\begin{array}{r}
2.19\\
\times\ 6.3\\
\hline
\end{array}
$$

A Chain of Products

Find the product.

1. 5.4×3.2

_____

2. Multiply the product in Exercise 1 by 1.5.

_____

3. Multiply the product in Exercise 2 by 0.5.

_____

4. Multiply the product in Exercise 3 by 2.5.

_____

5. Multiply the product in Exercise 4 by 9.4.

_____

6. Multiply the product in Exercise 5 by 3.2.

_____

7. Write Math ▶ Which exercise has a product that is less than the product in the exercise just before it? **Explain**.

_____

_____

_____

Zeros in the Product

Sometimes when you multiply two decimals, there are not enough digits in the product to place the decimal point.

Multiply. 0.9×0.03

Step 1 Multiply as with whole numbers.

$$\begin{array}{r} 3 \\ \times\ 9 \\ \hline 27 \end{array}$$

Step 2 Find the number of decimal places in the product by adding the number of decimal places in the factors.

$$\begin{array}{r} 0.03 \longleftarrow \quad \underline{2}\ \text{decimal places} \\ \times\ 0.9 \longleftarrow +\underline{1}\ \text{decimal place} \\ \hline \longleftarrow \quad \underline{3}\ \text{decimal places} \end{array}$$

Step 3 Place the decimal point.

0.027   There are not enough digits in the product to place the decimal point. Write zeros as needed to the left of the product to place the decimal point.

So, $0.9 \times 0.03 = $ **0.027** .

Write zeros in the product.

1.
$$\begin{array}{r} 0.8 \\ \times\ 0.1 \\ \hline \boxed{}8 \end{array}$$

2.
$$\begin{array}{r} 0.04 \\ \times\ 0.7 \\ \hline \boxed{}28 \end{array}$$

3.
$$\begin{array}{r} 0.03 \\ \times\ 0.3 \\ \hline \boxed{}9 \end{array}$$

Find the product.

4.
$$\begin{array}{r} \$0.06 \\ \times\ \ \ 0.5 \\ \hline \end{array}$$

5.
$$\begin{array}{r} 0.09 \\ \times\ 0.8 \\ \hline \end{array}$$

6.
$$\begin{array}{r} 0.05 \\ \times\ 0.7 \\ \hline \end{array}$$

Multiply and Compare

Write <, >, or = in the circle to make each comparison statement true.

1. 0.6×0.05 ◯ 0.03

2. 0.72 ◯ 0.9×0.08

3. 0.3×0.3 ◯ 0.06

4. $\$0.20$ ◯ $0.4 \times \$0.50$

5. 0.8×0.06 ◯ 0.48

6. 0.3×0.09 ◯ 0.039

7. 0.8×0.03 ◯ 0.06×0.4

8. 0.05×0.9 ◯ 0.07×0.6

9. 0.3×0.12 ◯ 0.4×0.09

10. 0.2×0.19 ◯ 0.8×0.05

11. **Write Math** ▸ **Explain** how you completed Exercise 10.

_____

_____

_____

_____

_____